Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

Vol. LIX. DECEMBER, 1920. No. 6

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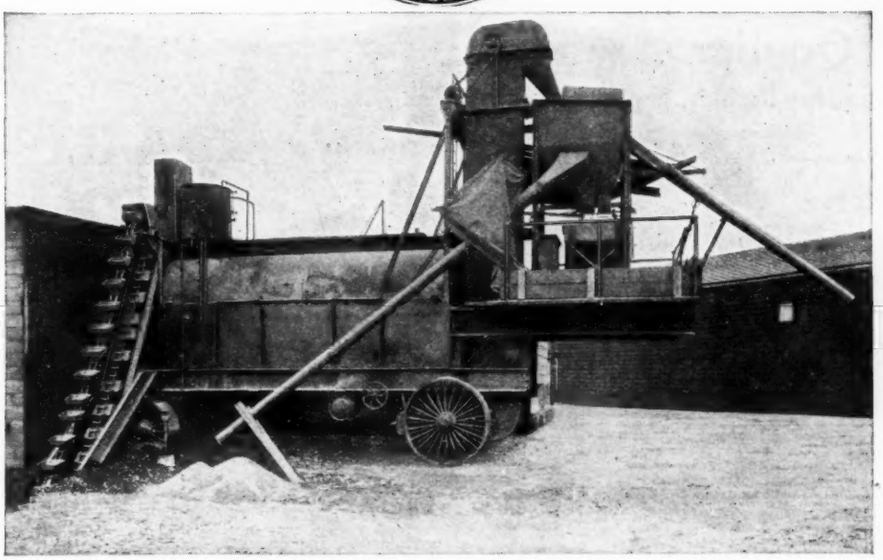

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MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation

CHAMPION SNOW PLOW, ATTACHED TO A WHITE TRUCK, AS OPERATED BY THE PENNSYLVANIA STATE HIGHWAY DEPARTMENT.

Printed as insert to MUNICIPAL AND COUNTY ENGINEERING, Chicago, Ill., December, 1920.

MOTOR TRUCK OPERATION AND ACCOUNTING LXIV

USE OF TRAILERS IN GARBAGE AND ASH REMOVAL

Modern System Adopted by a Dozen Cities Results in Better Service and Lower Costs—Teams Draw Single Trailers in House-to-House Collection and Trucks Haul Trailer Trains to Pig Farms, Incinerators or City Dumps—Record of Performance.

The growing problem of ash and garbage removal is being solved by a number of cities by the use of trailers and the authorities of many other cities are investigating the new system, together with other collection and disposal methods, in an effort to determine the best and most economical system for adoption.

Increased cost of doing the work with teams and wagons and the necessity of hauling greater distances to dumps outside of the cities are forcing the adoption of new methods. Among cities that have adopted the trailer system are Bridgeport, Conn.; Utica and Syracuse, N. Y.; Indianapolis, Ind.; Memphis, Tenn.; Norfolk, Va.; Dallas, Tex.; Detroit and Highland Park, Mich.; Cleveland and Akron, Ohio; Gary, Ind., and Kenosha, Wis.

The accompanying photographs and the following description of the way in which trailers are used will show some of the advantages and economies of the new plan.

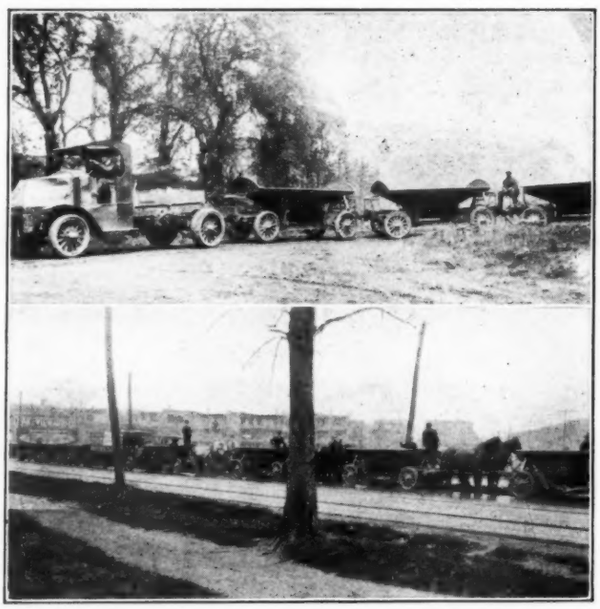
At Utica, N. Y.

For many years the collection of garbage in Utica was under private contract by means of teams and wagons, and at best was never very satisfactory. The contract expired at the end of 1918, and early in the winter the contractors asked to be relieved of the contract, which was done by the common council to save the contractors from bankruptcy and to avoid a condition that had become intolerable because of inability to carry on the work. Hundreds of complaints of non-collection of garbage were received monthly. The contract price paid was $4,100 a year, but when a call for new bids for 1919 was made the price asked by the old contractors was $8,000. However, a new firm which had established a pig farm about four miles outside of the city put in a bid for $3,100, and the contract was let to this firm at a saving of $4,900.

Owing to the length of haul the city decided to use trucks and trailers for the long-haul work and horses for house-to-house collection. It purchased two 5-ton trucks, sixteen 3½-yd. side-dump trailers and eight teams. Delivery of the motor equipment was made in April, and it was put to work at once.

The eight teams start from the central station at 8 a. m., each drawing a trailer and accompanied by two men. Each outfit starts collecting in a section assigned to it and in 1½ to 2½ hours has a full load. The trailer is then driven to a central point in its zone, where it meets the other loaded trailers.

About 9 o'clock the two motor trucks leave the garage, each drawing four empty trailers. Arriving at the rendezvous, the empties are disconnected and hitched to the teams, while the truck couples up to three or four loaded trailers. While the truck is on the way to the piggery to discharge the loads the work of collection proceeds in the city with the teams. Thus the trucks and their drivers, with one helper each, are kept constantly at work at full efficiency, while the teams and trailers, with their lower fixed and operating charges, are engaged in the slower work of collecting. The truck drivers are paid $3.50 a day and the other men $3. The last collection of the day is taken directly to the central station, where the horses are put in the stable and the loads hauled to the dump by the trucks.



MOTOR TRUCKS AND TRAILERS HAULING MUNICIPAL REFUSE.

Top: Truck and Trailer Train Leaving Incinerator Plant in Memphis, Tenn. Note Front and Rear Seats on Trailers, also Drop Frames and Low Sides of Dump Bodies. Bottom: Part of Bridgeport, Conn., Equipment of 16 Lee Trailers Used for Ash and Garbage Removal, Showing Method of Hauling Single Trailers by Teams for House-to-House Collection, and Train of Four Trailers Hauled by Motor Truck to Dump.

Six hours constitute the average day's work, and 35 to 40 tons of garbage are collected by each trailer. A small cash prize, offered each month for the best collection record, stimulates the men to competitive efforts. Experience with the system has increased its efficiency, and by dividing the city into collection zones, and operating the equipment on a regular time schedule, it has been possible to reduce the waiting time of loaded trailers to not more than 5 minutes.

The route to the pig farm is over unimproved country roads with grades of 7 to 8 per cent. in some places, but little trouble has been experienced in hauling the trailer trains. The 8-mile round trip requires about one hour,

DUPLEX TRUCKS

BUILT FOR BUSINESS

"Duplex Sets New Oregon Road Mark"

"Truck with Famous 4-Wheel Drive Gets Through Where Horses Can't Follow"

THESE headings were clipped verbatim from Oregon newspapers which devoted pages to the performance of the Duplex Truck that caused all Oregon motordom to recognize the Duplex 4 Wheel Drive as a wonderfully successful truck.

To quote further from one of the newspapers—"A Duplex 4-Wheel Drive Truck en route from Portland accomplished the remarkable feat Friday of going through Pass Creek Canyon under its own power.

"The truck is a three and one-half ton Duplex 4-Wheel Drive bought by Curry County for heavy construction work. Curry County wanted its truck right away, and as it could not be shipped to Gold Beach by railroad, the Duplex dealer decided to make a driveaway delivery of it.

"Even the county officials of Douglas County, who were called by long distance telephone, emphatically warned that the only way to get the Duplex through would be to ship it past the canyon by rail"

But the Duplex 4-Wheel Drive got through, and the Roseburg Review said: "The machine pushed through the oceans of mud along the line of the new dirt work, leaving a wake but little unlike that of a submarine chaser at sea."

The Oregonian stated: "A Duplex 4-Wheel Drive Truck has again wiped the word 'impossible' out of the road vocabulary of Oregon. The same Duplex that plowed through the mud of Pass Creek Canyon completed its journey across the Coast Range Mountains.

"It was delivered in good condition to the County Commissioners of Curry County at the town of Brookings after a run of nine days and approximately 450 miles."

Commenting further, the Oregonian says: "Once one of its rear wheels missed a culvert on a curve, hidden by the snow. Down dropped the wheel over the edge of the culvert until the axle bumped on it In this emergency the power in the two front wheels pulled the truck out of difficulty in a moment."

Road Dragging in Georgia

Spaulding County, Georgia, owns a Duplex 4-Wheel Drive Truck that in eight and one-half hours dragged 36 miles of road that formerly required a 12-mule team and double three-blade drag for three and one-half days.

The Duplex uses exactly the same equipment so far as dragger is concerned.

The road commissioners of a county in Iowa report that since using their Duplex 4-Wheel Drive, it replaces horses and mule teams and haulage costs have been cut squarely in two with a corresponding big saving in time.

Scarifying and Grading in One Operation

Down in Franklin County, Missouri, they have a Duplex 4-Wheel Drive which they use to haul a scarifier and a 6-horse grader, both at once.

The Secretary of Franklin County says in a letter: "We hold high place in this part of the country for building more and better roads at lowest cost."

Whatever kind of construction work you have to do, you will find the Duplex 4 Wheel Drive to be the most powerful and the most successful truck in America.

See the Duplex dealer near you and have him arrange for any kind of a demonstration—either by itself or in competition with any other truck that you can induce to make the test. 3½ tons capacity, price $4250, f. o. b. Lansing.

For all 'round high-speed work, nothing can beat the world's record Duplex Limited—medium capacity, electrical equipment, pneumatic tires.

It ran 935 miles in 24 hours continuous operation on the Indianapolis Speedway, October 1. Price, $2775 f. o. b. Lansing.

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including about 8 minutes for dumping the trailers down a wide chute built at an incline of 45 degrees to the feeding pens. Uncoupling and coupling trains in the city requires 10 to 15 minutes.

The trailers have drop frames, so that the sides of the steel bodies are only 5 ft. from the street level and about 4½ ft. above the curb. This makes loading easy and saves time. It also means a great deal to the men engaged in the work.

In the first three months following adoption of this system—May, June and July, 1919—the number of collections was increased from 3 per month to 8; complaints received decreased from 417 to 64; length of haul increased from 1.6 miles to 4 miles; tons loaded increased from an average of 573 per month to 749, and total cost from a monthly average of $2,328 to $4,032. This greater cost is accounted for by the increased length

VIEW OF 4-YD. 3-TON SIDE DUMP TRAILER, SHOWING BODY IN DUMPING POSITION, ALSO LEVERS FOR OPERATING BODY-LOCKING MECHANISM.

of haul, which was necessitated under any system. The ton-miles with teams for the shorter haul under the old system averaged 900 per month and the cost per ton-mile $2.54, while with the trailer system the ton-miles averaged 3,000 and the ton-mile cost $1.35.

In the eight months' period from April to November, 1919, inclusive, the trucks covered 11,000 miles. Collections totaled 6,283 tons as compared with 5,000 tons under the old contract system in the corresponding period the previous year, and the cost per ton-mile averaged $1.26 as against $2.36 with teams.

At Memphis, Tenn.

The City of Memphis uses a similar system of garbage collection, but disposes of the refuse in an incinerator plant. Collection is by individual trailers drawn by horses. The trucks haul three loaded trailers in a train and the trailers are dumped simultaneously on the concrete floor of the incinerator plant, where the loads are shoved through holes into the furnaces below.

At Indianpolis and Detroit

Indianapolis has used trailers for ash and garbage removal for more than a year, and has an equipment of twenty-five. Three loaded trailers are hauled to the city dump in a train drawn by a motor truck. The trailer bodies hold 4 cu. yds.

Operations in Detroit are not so extensive as in Indianapolis, but the trailers used are provided with a seat and foot rest at either end for the driver when on collection work with teams.

At Bridgeport, Conn., and Dallas, Tex.

Bridgeport uses an equipment of sixteen trailers and Dallas has purchased 40 trailers and 2 new trucks at a total cost of $90,000. Its entire garbage collection and disposal has been motorized, and it is expected there will be a great saving over the cost of the work with horses and wagons. Half of the trailers were delivered to the city early last October, at which time the trucks were also ready for delivery.

At Other Cities

Fifteen garbage trailers are in successful operation in Winnipeg, Manitoba. Syracuse, N. Y., let a contract for 30 trailers and several trucks last spring to completely motorize its ash and garbage removal. Buffalo also recently awarded a contract for considerable trailer equipment.

Demonstration trailers are being tried out in similar work in Philadelphia and Savannah.

The Hoboken Problem

Several cities in Northern New Jersey are investigating the subject, notably Newark, Hoboken, Jersey City and Passaic. The city of Hoboken has a problem, as it has no place to dispose of ashes and garbage inside the city limits and is adjoined on the north and south by the incorporated cities of Weehawken and Jersey City, while confronted to the east by the Hudson River and hedged in on the west by the Palisades and the town of Union Hill. It has investigated the feasibility of disposing of the refuse by barges, towed to sea, by railroad, by trolley, by incinerator and by truck and trailer. The most feasible and economical seems to be by truck and trailer, with a haul up a viaduct of 5 to 6 per cent. grade to the top of the Palisades and 6¾ miles to a dump at Secacous, in the Jersey or Hackensack meadows. An incinerator plant would call for an investment of many thousands of dollars and would be a nuisance, not only to its own citizens, but to those of adjoining communities. Removal by electric railway would require a loading yard with ramps in the heart of the city. Up to the present time mixed ashes, paper and garbage have been disposed of on vacant lots in the center of the city, but this must be discontinued. The city has a population of about 70,000 concentrated in an area of 1⅛ square mile. There are approximately 48 miles of streets and there are six daily collections per week throughout the city. The maximum amount hauled per day is 480 cu. yds. The work is now being done with twelve 2-horse, 2-yd. bottom dump wagons.

The chief difficulty standing in the way of adoption of truck and trailer service is a provision in the motor vehicle laws of the state that prohibits the towing of more than one trailer or semi-trailer by a motor truck or tractor. Inquiry has been made of the Commissioner of Motor Vehicles by the authorities of Newark and other cities whether exception could not be made of equipment operated by city departments, but he held that he had no authority to grant an exception. Efforts were made in the legislature last winter to secure an amendment to the law that would allow the towing of two or

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EACH piece of material-handling equipment turned out by Mead-Morrison Engineers has proven itself not only remarkable for the ease with which it performs difficult work and saves time and money, but also for the gratifying way in which it maintains a steady average of accomplishment.

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Under-Slung Truck Winch

The Under-Slung Winch—the latest Mead-Morrison product—is typical of Mead-Morrison ingenuity and efficiency.

It fills a long-felt want among telephone companies, street railways and logging camps. Instead of being placed on the floor of the truck it is attached to the rear where it is easily accessible for work of the sort done by the above named industries.

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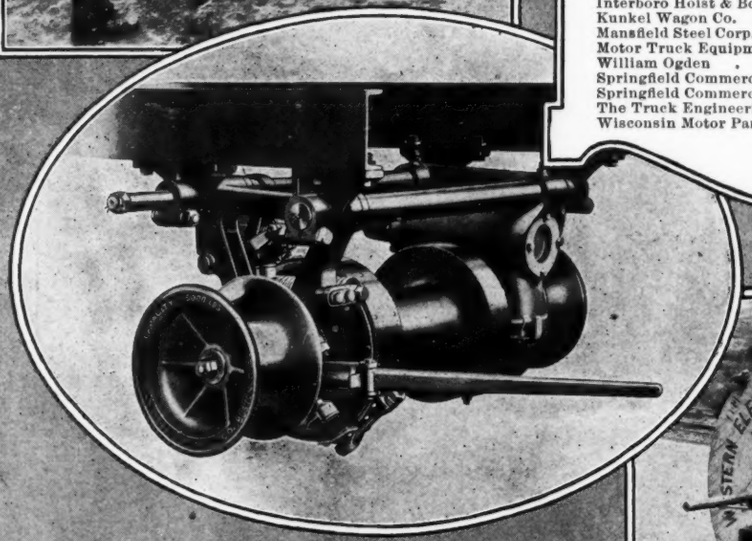

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A CHAMPION SNOW PLOW OPENING A SNOW-FILLED ROAD.

three trailers by a single truck or tractor, so that cities and contractors engaged in highway construction might make use of this most economical hauling method. But the amendment was opposed by the State Highway Commission and by some of the county engineers, and died in committee. It is now rumored that a more enlightened sentiment will prevail at the next session of the legislature and that some amendment will be passed that will afford the cities of the state the relief they seek.

RELATION OF THE PROPOSED UNIFORM TRAFFIC LAW TO MUNICIPAL TRAFFIC REGULATIONS

By H. G. Shirley, Secretary, Federal Highway Council, 1311 G Street, Northwest, Washington, D. C.

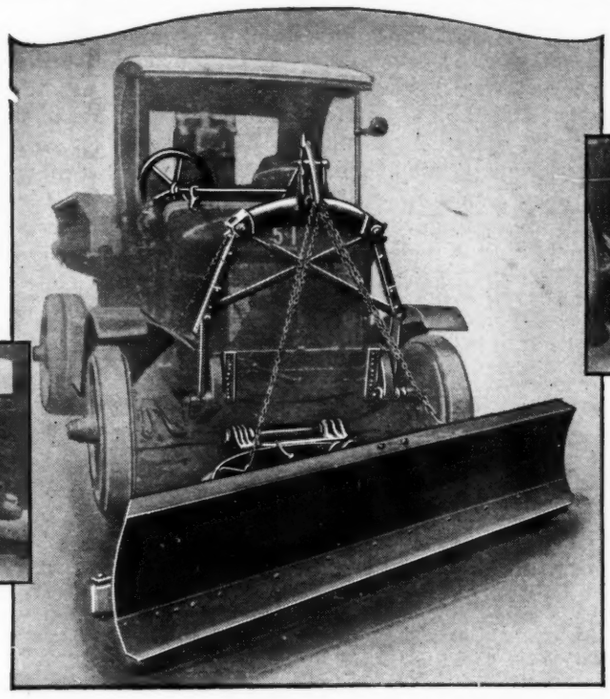
Laws are always drawn to meet a need, whether this need is one to correct an abuse or to protect individuals and property, it must exist, and be so insistent as to demand public support in the enforcement of any law enacted.

In drawing up the proposed Uniform Vehicle Law a thorough study was made as to just how far this law should go in regulating and controlling traffic in municipalities, it being realized that in the large centers of population a special control of traffic was necessary and should be provided. Therefore, only the basic provisions that should govern and control traffic throughout the state were made state-wide. In arriving at these factors that should be made state-wide the committee carefully considered the effect they would have on the safe and expeditious handling of traffic in all municipalities and towns, and the good that would come from such a general regulation, said Mr. Shirley in his paper before the 192 annual convention of the American Society for Municipal Improvements.

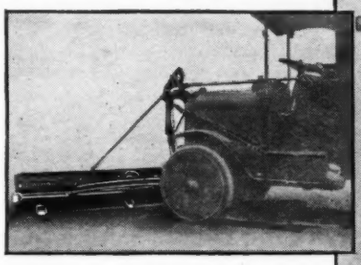
Need for Uniform Law

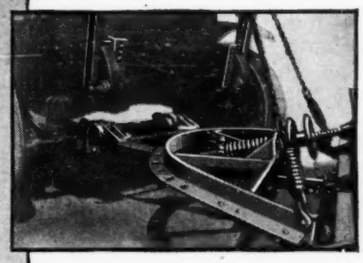
We have seen in the earlier days of motor legislation every district, town, municipality, and county specified a certain speed, load, kind of tire, lights, signals, etc., that should be used, each unit of government having a different requirement, thereby forming a hodgepodge conglomeration of laws and ordinances, making it impossible for any individual to operate a vehicle without violating many of their provisions. Under such conditions abuses crept in. Slow rates of speed would be established, and

THE ROAD OPENED AND READY FOR TRAVEL. THE JOB WAS DONE QUICKLY AND AT SMALL EXPENSE.



Champion Snow Plow, showing rear view of scraper bar.





Close up, showing improved axle clamp, semi-circle, tilting mechanism, etc.

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These plows are attached to any standard motor truck and can be detached at will. The truck is available for any other purpose when the plow is not in use.

Champions are made throughout of the very best materials. The wearing parts are of high carbon steel. The connections to the truck are of forged and structural steel. The castings are all of the very highest grade. An important feature is the automatic blade release, so constructed that when the cutting edge strikes an obstacle such as a manhole cover or car track, the blade releases to pass over the obstruction and then immediately returns to the operating position.

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everyone who passed through the village exceeding this speed would be arrested, a heavy cost placed against the operator, and a small fine. The cost was divided between the officer making the arrest, and the magistrate and was a very profitable business. Whereas the amount going to the town or village was exceedingly small. This abuse alone made it imperative to have a uniform speed throughout the state. Therefore, properly to govern the transportation on the highways and bring it under reasonable control it was necessary to establish a few fundamental principles that should not be interfered with by city or town ordinance, and that these principles should be recognized by all municipalities, and co-ordinated with such additional regulations as may be necessary.

In drawing the Proposed Uniform Law it was specified that no other license fee other than the one paid to the State should be levied against any vehicle with the exception of the property tax placed on all property. The minimum rate of speed was specified for open country, suburban sections, and closely built up sections of cities and towns, giving the municipality the right to increase the speed if deemed advisable, but under no condition should it be diminished.

State-Wide Provisions

A study of the ordinances of the larger centers of population was made and it was found that on certain boulevards a higher rate of speed was allowed than proposed. It was therefore considered advisable to allow cities or towns to establish a rate of speed in excess of that considered safe on narrower streets under heavy traffic. The provisions proposed to be state-wide are as follows: license fee, signal devices, brakes, load plates, lights, speed, weight, length, width and height. (Length is not supposed to cover motor driven street cars.)

The license fees are based on the horse-power plus a charge for 100 lbs. per gross weight of vehicle and load; pneumatic tires on the basis of 50 per cent. lower than that of steel.

Every motor vehicle shall be required to be equipped with a signalling device or suitable horn for producing an abrupt sound as a signal or warning of danger.

Suitable brakes shall be required—two sets operating independently. All vehicles shall be equipped with a load plate, giving the actual weight of vehicle, with equipment and the weight of the seating or loading capacity of such vehicles as specified by the manufacturer.

Lights on all vehicles shall be such as to give sufficient power to enable the operator to proceed with safety to himself and the other users of the highways. Every motor vehicle shall have mounted on the right and left side of the front a pair of lamps, and if said vehicle is so mechanically constructed, governed or controlled that it cannot exceed a speed of 15 miles per hour it shall have front lamps capable of furnishing light of sufficient candle-power to render any substantial object clearly discernible on a level highway at least 50 ft. directly ahead and at the same time at least 7 ft. to the right of the axis of such vehicle for a distance of at least 25 ft. If said vehicle can exceed a speed of 15 miles per hour, then it shall have front lamps capable of furnishing light of sufficient candle-power to render any substantial object clearly discernible on a level highway at least 200 ft. directly ahead and at the same time at least 7 ft. to the right of the axis of such vehicle for a distance of at least 100 ft., provided that no front lamp capable of furnishing more than four candle power light shall be used if equipped with a reflector, unless so designed, equipped or mounted that no portion of the beam of light when projected 75 ft. or more ahead of the lamps shall rise above a plan 42 ins. higher than and parallel with the level surface on which the vehicle stands; and provided, further, that no electric bulb or other lighting device of a greater capacity than 31 candle-power shall be used, no matter how the same may be shaded, covered or obscured.

SPEEDS

(a) Vehicles designed for carrying not more than seven passengers.

Maximum weight, including gross weight of vehicle and load	Open country highway	Suburban streets	Urban streets
6,000 lbs.	30 miles	20 miles	15 miles

(b) Other vehicles, equipped with pneumatic tires.

Maximum weight, including gross weight of vehicle and load	Open country highway	Suburban streets	Urban streets
6,000 lbs.	25 miles	20 miles	15 miles
8,000 lbs.	25 miles	20 miles	15 miles
12,000 lbs.	25 miles	20 miles	15 miles
16,000 lbs.	25 miles	20 miles	15 miles
20,000 lbs.	25 miles	20 miles	15 miles
24,000 lbs.	25 miles	20 miles	15 miles
28,000 lbs.	25 miles	20 miles	15 miles

(c) Vehicles equipped with solid tires.

Maximum weight, including gross weight of vehicle and load	Open country highway	Suburban streets	Urban streets
4,000 lbs.	25 miles	20 miles	15 miles
8,000 lbs.	20 miles	18 miles	12 miles
12,000 lbs.	18 miles	15 miles	12 miles
16,000 lbs.	16 miles	15 miles	12 miles
20,000 lbs.	15 miles	15 miles	12 miles
24,000 lbs.	15 miles	15 miles	12 miles
28,000 lbs.	15 miles	15 miles	12 miles

Weight, Length, Width and Height

No vehicle of four wheels or less, whose gross weight, including load is more than 28,000 lbs.; having a greater weight than 22,400 lbs. on one axle, and no vehicle having a load of over 800 lbs. per inch width of tire upon any wheel concentrated upon the surface of the highway shall be operated on the highways of a State, except by special permit granted.

No vehicle shall be operated on the highways whose length is more than 30 ft. and no combination of vehicles coupled together shall be so operated whose total length, including load, shall be greater than 85 ft., except by special permit granted.

No vehicle shall be operated on the highways whose width, including load, is greater than 96 ins., except traction engines whose width shall not exceed 108 ins.

No vehicle shall be operated on the highways whose height is greater than 12 ft. 6 ins.

The provisions of license fee, gross weight, weight per inch width of tire, the maximum speed, length of vehicle, width of vehicle and height of vehicle, kind of lights, signal devices, tires, and certain simple fundamental rules of the road are made state-wide but the rules of the road do not interfere with the traffic plans of any city where traffic regulations are provided. It was, however, deemed prudent and advisable to make a few traffic provisions state-wide so that chauffeurs and operators of vehicles would know the general rules of the road and would operate their vehicles in accordance therewith.

Law Intended to Aid Traffic

A motor vehicle has flexibility and is capable of carrying loads over large areas. It is not confined to towns or municipalities, and it was necessary to make a few fundamental principles of this law state-wide, so that a driver of a motor vehicle would know exactly what to do and what was required of him in operating his car over the highways. The main object of drawing this law was not to restrict but to expedite the handling of traffic and for the protection of property and lives of the people. When a driver has become familiar with this law he will be able to operate his vehicle in any town or city without violating any of its provisions, and it will in time become so well known that in the movement of traffic every driver will fall into his proper place, which will expedite the movement of vehicles to a very great extent.

It must be clearly understood that this law is not to supersede or in any way curtail the handling of traffic by traffic officers in large cities. That is a problem of the greatest importance and means much to the economical welfare and progress of such a municipality, but it is very essential that all the people of a state should know the speed allowed throughout the state, character of lights, the signal devices, the requirements as to loads, tires, character of lights, the signal devices, the requirements as to loads, tires, length, width, and height of vehicles so that a man traveling from one town to another would not violate the common laws that should be known by every driver. This law applies to horse drawn just as it does to motor driven vehicles, and its enforcement should be in the hands of the police of the state outside of the municipalities and cities, but within the corporate areas should be administered by the police of the city.

In drawing the Proposed Uniform Vehicle Law the committee kept in mind the necessity of making it as simple as possible, with a view to having it adopted by the legislatures of the different states, and it was only drawn to meet an emergency for a uniform vehicle law throughout the entire country.

NOTES ON TRUCK OPERATION

Loaded Truck Gains 168,000 Miles Over Team in Five-Year Haul

In discussing the question of horse hauling vs. motor truck, W. A. Carpenter of the Acme Motor Truck Co., Cadillac, Michigan, says:

"While very much has been said upon this subject, the following comparison will illustrate in a striking way the difference between the two methods, and may present the matter in a different light than truck users have seen it before.

"The average 2-horse team will haul 2 tons over the average road, at a speed not greater than 3 miles per hour. Allowing one hour for the noonday stop, and another hour for loading, unloading, resting on grades and miscellaneous delays, it is safe to say that the team will in a 10-hour day cover not more than 24 miles. But at least one hour in the early morning before starting on the trip, preferably longer, must be allowed for the horses to be fed, curried, harnessed and watered, also part of the noon hour must be devoted to care of the horses and at night after working hours, some little time must be devoted to feeding, watering, bedding and currying them. All of this extra work must be done outside of ten working hours, to say nothing of veterinary services. So much for the horse hauling method.

"Now for the truck's side: No preliminary work in the morning is necessary, with the exception of a few moments' inspection every morning, desirable in any piece of machinery. Allow the same two hours lost time each day for truck as allowed for team, though the hour allowed for such delays will be confined to loading and the greater part of this time eliminated. At the close of the first day the truck will be 136 miles from place of starting (remember the team has made but 24 miles). At the close of 300 days, truck will be 40,800 miles from the starting point, though during the 300 days the team has covered only 7,200 miles. In other words the truck has carried 2 tons 33,600 miles further than the team did in the same length of time. Keep this up for say five years, if the horses are able to work steadily 300 days per year for five years, and we find the truck 168,000 miles ahead of the team. Counting feed, care and upkeep of team, harness and wagon, the cost of operation and maintenance is about the same for truck as for team, at least not much more, if as much.

"Hence there can be no argument concerning the efficiency of the two methods of hauling. The investment, of course, is much greater with the truck than with team, but as will be seen from above, the results do not compare favorably to the horse."

Federal Factory on Full Time Schedule

The factory of the Federal Motor Truck Company at Detroit, Michigan, is operating on a full time schedule according to an announcement made by M. L. Pulcher, vice-president and general manager of the company. Sufficient orders are on the books to warrant the assumption that there need be no fear of the curtailment of production in the future and the company is making every preparation for an even greater output during the coming year.

A new addition to the Federal plant adding 60,000 sq. ft. to the 300,000 sq. ft. of factory space in the Federal plant has just been completed. This new addition will house the final assembly and paint departments.

Business conditions, according to Mr. Pulcher, are "getting better fast." The result of the election combined with the general feeling of optimism on the part of business and the realization of the present importance of the motor truck to industry is having a decidedly beneficial and strengthening effect upon the motor truck industry.

Motor Truck in Railroad Service

"The motor truck's greatest development is yet to come," says James G. Heaslet, president of the Signal Motor Truck Co. of Detroit. "It is in the field of railroad service, where motor trucks are bound to take a constantly increasing and more responsible role."

"Trucks to be supplied the railroads are expected to consist of chasses mainly. They will be used in connection with special goods-wagons or boxes, which will be constructed to fit right on to the chasses and be placed aboard by means of overhead cranes. When a goods-

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PIERCE-ARROW has been noted always for freedom from breakdowns and minimum repair expense. The accessibility of every part materially cuts down labor cost of necessary repairs. Keeping trucks running is an essential of successful operation and a major Pierce-Arrow objective.

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THE PIERCE-ARROW MOTOR CAR COMPANY, BUFFALO, N. Y.

wagon is filled and ready to be transported it will be swung on the chassis and taken to the railroad yards, where it will be hoisted aboard a flat car, capable of accommodating three of these goods-wagons. From this point the goods-wagon will travel to its destination via rail, and upon arrival another motor truck will swing alongside, the crane again be called into use, and this time the goods-wagon is swung aboard a motor truck that brings it direct to the actual point where the goods are required. The result will be door-to-door deliveries affected by the railroads, and no more goods tied up in warehouses for indefinite lengths of time waiting weeks and even months for someone to come and take them away.

"It will even be possible for us to ship merchandise by this method to a seaport, where the goods-wagon will be lowered into the hold of a ship bound for a distant port. This will save a great many handling charges and much time lost in trans-shipping. Upon arrival at the foreign destination the goods can be delivered at a great saving of money."

Over 10,000 Motor Haulage Lines in Operation

"Evidence of the tremendous growth of motor trucking in the United States is substantiated by the fact that today there are over 10,000 motor haulage lines in this country, some of which have invested as high as $2,000,000 in their trucking equipment," says Jas. G. Heaslet.

"This tremendous investment is a tribute to the efficient service that these motor haulage lines have rendered the country in the past few years. In addition to transporting food, the other three necessities of life—fuel, raw material and manufactured articles—have been hauled by the ubiquitous motor truck.

"The motor truck is gradually taking a dominating place in the haulage of all these articles, except for distance heavy haulage. The retail distribution of fuels such as coal and oil naturally falls to the trucks.

"They are also effectually used in the transport of all kinds of raw material. They are used in mining copper, graphite, gold, lead, manganese, mercury, phosphate, salt, silver, sulphur, and zinc. Building materials such as gravel, leather, lumber, cement and sand are all very largely handled and distributed by trucks. Immense lumber sections in the northwest, which otherwise could not be tapped, are being reached by them.

"The greatest problem in connection with the movement of freight is involved in the terminals. The motor truck is singularly free from this drawback, its ability to give door to door service constituting one of its most distinctive and inestimable advantages. Producers and manufacturers want goods to go right straight through to their destination with a minimum of handling, and this service the motor truck efficiently performs for them."

Duplex Limited in Record Run from New Haven, Conn., to Montreal, P. Q.

Recently the firm of Knight & Rice of New Haven, Conn., decided to drive their new Duplex Limited to Montreal, Quebec. A distance of 900 miles was covered and the truck averaged 12½ miles to the gallon of gasoline. The entire trip was made on three quarts of oil. The truck carried a load of furniture weighing slightly more than 2 tons. For long distances an average speed of 22 miles per hour was maintained. One of the owners of the truck, who made the trip, said:

"We had no engine trouble, nor tire trouble, neither going nor coming and the truck rode like a touring car. Of course it may not be generally known just what type this Duplex truck is: it is built to run and ride like a touring car and carry a two-ton load."

Truck Caravans Familiar Sight as Rails Falter

Industry in the United States has outgrown the whole system of rail transportation, experts assert. It will be a year, they say, before even the existing equipment can be restored to efficiency and years longer before the expansion of facilities necessary for the rails to "catch up" to the demands of business can be accomplished. Meanwhile, business everywhere, with its customary resourcefulness, has sought relief elsewhere. Cut off at the round house, it has turned to a garage. There—in the motor truck—it has found succor.

Inter-city shipping by truck, which under ordinary circumstances is included in the short haul category, was commonplace even before the railroads began to falter under their burden—as ordinary, almost, as the motorization of hauling and delivery within the city. When the already overworked railroads were hit by the switchmen's strike, shipping for a time received what amounted to a near knock-out blow.

It was here that the motor truck stepped in, not only in a legitimate way on short hauls, but, as the demand grew, on hauls that grew longer and longer, until the 1,000-mile mark had been passed in numerous instances. Now, the experienced truck maker knows that under ordinary conditions there is no economy in truck hauls of such distances. Hence he would not recommend them except in cases of great urgency.

However, many an emergency did arise which sent motor trucks over the roads on long trips. True, the cost of these ventures was high, but shipper and consignee alike considered the expenditure an ultimate economy after estimating the financial loss through delayed shipments and loss of business that would have been entailed by waiting for shipment by rail. Weighing conditions and consequences, they considered emergency long hauls by motor caravans justified, but only emergency long hauls.

Trucks Save Knitting Mill

A case in point: In order to keep its factory running, the Bradley Knitting Mill, Delavan, Wis., had to have yarn—freight embargoes notwithstanding—from the Attleboro, Mass., plant of R. Wolfenden & Sons, commission dyers and bleachers. A White 5-ton truck was called into service. With a cargo of worsted yarns valued at nearly $35,000 the truck, operated by the Globe Coal Company, Woonsocket, R. I., set out on a scheduled round trip of 2,300 miles. The contract price for the trip was $2,888.85 or approximately $2.40 per mile one way—$1.20 per mile for the entire route.

Normally, the yarn would have been shipped by freight. But here was an emergency, to be met promptly. Had the truck not been thrown into the breach, curtailment of production at the Bradley Knitting Mill would have been necessitated. The extra expense of shipping the

cargo by truck was more than justified, officials felt, by the urgency of their need.

Similar situations, similarly met in other parts of the country, raise the question whether use of trucks, though involving increased expense, was not an ultimate economy. Suppose delayed shipments of raw material had been allowed to force suspension of production, with a consequent loss of time for employes! Very shortly, lost time and decreased production would have proved more costly than emergency use of trucks for long hauling of needed raw materials.

Less tangible, but none the less real, was the danger of weakened prestige by failure promptly to fill certain orders, a danger that proved to be the closing factor in the decision of certain firms to use trucks on emergency long hauls. Although impossible to compute in dollars and cents, prestige—it was realized—was worth protecting even at some expense.

Needed Machines Hauled Overland

When the Troy Foundry Company of Troy, N. Y., found that the railroad strike was holding up molding machines needed for an addition to the plant, officials of the Consolidated Trucking Company were asked to send one of their trucks to Milwaukee to bring back a load of the machines. Delay could not be countenanced, as a large order from an electric company was waiting to be

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"A shut down of the plant threatened—2,000 men laid off—all for the need of a few bolts. Our usual source of supply was cut off. There had been a strike at their plant and along with the railroad situation, it delayed our shipment.

"I called a friend to help me out. He said, 'Can't you find anything in MacRae's.' 'What's that,' I asked. He seemed surprised that I had been a purchasing agent so long and didn't know what MacRae's Blue Book was. I was too, after he sent over his copy and I found so many manufacturers who made bolts.

"The result was a quick delivery of enough to keep the plant going, at a lower price than usual.

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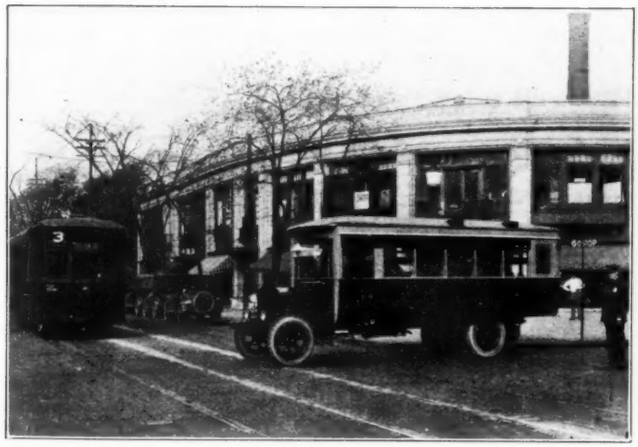
filled. C. H. Watson, who looks after the trucks, selected a 3-ton White for the trip and decided to drive it himself. Full loads were carried both ways. Taking on a 3-ton load of castings consigned to the Wright Cutter Company of Chicago, Watson made the 1,300-mile trip in eight days. Eight hours of additional driving took him to Milwaukee, where he piled on ten of the bulky molding machines and started back east—on the return leg of a jaunt covering 2,700 miles.

But emergency hauling over long distances, or transporting perishable goods quickly when the demand is urgent, are merely minor phases of truck utility. The point to be kept clearly in mind is that the truck's great worth is in transportation work under normal conditions.

Pierce-Arrow Puts New Type of Motor Bus Into Active Use

Traction authorities are being invited by the Pierce-Arrow Motor Car Company of Buffalo, N. Y., to view the new type of motor bus which recently was put into active service in Buffalo by the company. This bus, mounted on a Pierce-Arrow two-ton Dual Valve chassis equipped with pneumatic tires, seats 25 persons comfortably and is described as a brother to the modern street car.

"Because a number of electric railway companies already have augmented their regular equipment with fleets of motor busses, traction authorities are watching with interest the development of this vehicle," says Robert O. Patten, trucks sales manager of the company.



NEW TYPE MOTOR BUS RECENTLY PLACED IN SERVICE IN BUFFALO, N. Y., BY THE PIERCE-ARROW MOTOR CAR CO.

"The electric railway industry has come to regard the motor bus as an ally; not as a competitor. The bus enables the electric railway to give service in newly-opened sections without going to the enormous expense of laying tracks and investing in new rolling stock. It likewise can be used to relieve the heavy passenger traffic burden during rush hours. By running the busses on streets paralleling the trolley streets, congestion is avoided and the electric cars make faster headway.

"In cities where trolley companies have added motor busses to their equipment, experience has shown that the bus service is comparable in headway, speed, fare and transfer privilege and economy of operation with the trolley service."

The type of bus recently perfected by the Pierce-Arrow company marks a distinct advance in bus construction. The steel body is fitted with all the know safety devices and modern conveniences, including electric lights, push buttons, a heating system and window screens and shades. The riding qualities may be compared to those of a Pullman coach. The driver and passengers have clear vision on all sides. The bus attains a speed of 23 miles an hour with ease, and handles well in traffic. Although commodious, the bus is of such efficient design that it does not give the impression of bulkiness, and it conforms to state and city regulations.

A Defense of Heavy Capacity Trucks

"Of all the various shortages harassing this country today, none is more menacing to our national welfare than the shortage of transportation," says A. F. Masury, Vice-President and Chief Engineer, International Motor Co. "It was largely the realization of this fact that caused our Government to appropriate some $800,000,000 to be spent in the course of the next few years for the improvement of highways to permit a more extended use of the motor truck.

"In expending this amount, the United States is, in reality, buying a certain number of ton-miles of load carrying ability or in other words highways, the value of which will depend on the amount of material that can be transported over them. The return on the investment will be determined not alone by the type and construction of the highways built, but also by the capacity and design of the vehicles operated over them.

"As a first step toward securing the greatest return in transportation from the money spent on highway improvement, the Bureau of Public Roads at Washington has conducted extensive experiments in order to determine the type of highway which will give the largest number of ton-miles of load carrying ability per dollar expended. However, the other phase of the problem—that of regulating motor vehicles so as to get the greatest tonnage transported with the least damage to the roads—presents much greater difficulties, since the decision rests, not in the hands of a centrally located group of technically informed men, but with numerous widely scattered legislative bodies. The ineffectiveness of this arrangement can be seen by the fact that methods of restricting motor vehicles vary widely in all parts of the country. While it is certain that every legislature passing a law to establish license fees or restrict traffic, does so in an earnest effort to conserve the roads, there is a strong tendency on the part of those not fully apprised of real facts to assume that small trucks cause less road wear than large trucks and that they should therefore be favored.

"Consider for a moment, the effect of legislation that has favored the lighter capacity truck. Regardless of whether the material is to be shipped in large or small trucks, the demand for truck transportation remains the same, as practically none of it can be diverted to other channels. As a result, when large unit haulage is discouraged, the same amount of freight is merely divided up among a greater number of smaller vehicles, running at far greater speeds and increasing the cost of hauling by a very considerable percentage.

"If this decreased the amount of road wear and permitted our $800,000,000 investment to obtain more ton-

miles of load carrying ability, it is possible that the increased cost would be justified. But this is not the case. A careful consideration of the effect clearly shows that to substitute smaller trucks for large ones, unquestionably *increases* road wear. To illustrate,—suppose each dollar spent in highway improvement as an arbitrary figure, buys 1,000 ton-miles of load carrying ability. Bearing in mind that two kinds of weight travel over these roads—weight of load and weight of vehicle—it is obvious that the dividends on our investment will be determined by the proportion of this traffic which is useful weight—or weight of load. The 7½-ton truck has less than 1 ton of vehicle weight for each ton of capacity; hence, if all the vehicles operating over this dollar's worth of highway were of 7½-tons capacity, then that dollar would provide for 500 ton-miles of useful load transportation. A 1-ton truck, on the other hand, ordinarily weighs over 2 tons itself and so if this size were used entirely, the same dollar's worth of road would give only 333 ton-miles of useful load transportation as two-thirds of the road's carrying ability would be used in transporting the weight of the truck.

"The design of the vehicle, as well as size, has an important bearing on the potential returns of our $800,000,000 investment. Certain tests conducted by the Bureau of Public Roads at Washington show that road impact, which is the principal cause of road wear, does not necessarily increase in proportion to the size of the truck, but is governed by the amount of weight which a truck carries below its springs. For instance, a 5½-ton chain-driven truck fully loaded, delivered only 68 per cent. of the road impact pressure produced by a 3-ton shaft-driven truck operating under the same conditions and carrying the same tonnage. In a shaft-driven truck, all of the final driving mechanism is carried below the springs and this weight delivers a continual series of direct solid blows to the road, while in a chain-driven truck there is no weight below the springs except that of the wheels and a comparatively light axle. That is why a 7½-ton chain-driven truck will produce less road impact and consequently less road wear than a 5-ton shaft-driven truck. And, furthermore, that is why vehicle design should be considered in framing legislation to derive the greatest possible benefit from our $800,000,000 highway investment.

"Unfortunately, this subject of gross weight restriction is too easily misunderstood. The tendency to jump at conclusions in determining which types and sizes of motor vehicles exert the greatest road wear is a very natural one, owing to the popular confusion between "static weight" and "impact weight." To be sure, a 7½-ton truck standing still is heavier on the road than a 5-ton truck regardless of whether it is chain or shaft-driven. But static weight does not wear out the roads, as was proved by the Government tests and as any one can readily see. It is the constant impact pressure caused by a moving truck—the repetition of shocks or blows—that alone affects the road surface and its foundation. And it has been conclusively proven time and again that final drive construction has an exceptionally important bearing on impact pressure—that in motion, a 7½-ton chain-driven truck produces less impact pressure, and consequently less road wear than a 5-ton shaft-driven truck. Is it not reasonable, therefore, for the people of this country who are paying this $800,000,000 for highway improvement and who are vitally concerned in transportation costs as they affect commodity prices, to demand that legislators apprise themselves of the facts concerning motor vehicle design that will provide a method for both lengthening the life of the highways and lowering transportation costs?

"It is conceded that vehicle restriction in one form or another is a prime necessity in getting the most out of this huge investment but when proof of the fact that large capacity chain-driven trucks will reduce transportation costs and reduce road wear is so conclusive, does it not seem that vehicle design is worthy of consideration as a basis for framing restrictive legislation? Is it not the duty of legislators to base their efforts on something more than assumption—to analyze the effect of substituting a greater number of high speed small trucks for fewer large trucks, and to listen or study the tests made by Government officials that a consideration of vehicle design will increase the effectiveness of our $800,000,000 highway investment by at least 50 per cent.?"

CONCRETING BEGINS ON WORLD'S LARGEST ROAD JOB

Actual concreting on the first stretch of Twohy Bros.' 280-mile concrete road job in Maricopa County, Arizona, was begun Nov. 12. Two mixers, operating from what is known as the Fowler setup, will lay the first 41 miles of 16-ft. road at the rate of 1,300 ft. a day, it is estimated, before the material trestle and cement shed are moved. One mixer is seven miles from the material plant, the other two miles.

A second plant is being installed at Chandler identical with the one at Fowler. The Chandler plant will begin operations about January 1. With the two plants Twohy Bros. expect to build 280 miles of 16-ft. road in three years from eight setups.

Materials are delivered in bottom dump railroad cars. The cars are shunted on top of a material trestle and dumped direct into bunkers under the trestle, from which the tip-over batch boxes are loaded by gravity.

Sand and gravel are obtained from Tempe, where Twohy Bros. have installed a washing and screening plant having a capacity of 1,500 yds. per day. Cement is received in bulk and unloaded by means of a Dracco vacuum plant arranged and furnished for this job by the Lakewood Engineering Company. From the time it is loaded into railroad cars the material does not touch the ground until placed on the road as concrete. The most modern methods are used in every operation. The equipment, representing an investment of nearly a half million dollars, includes four 14-E Lakewood gasoline pavers with batch transfers, 18 miles of narrow gauge road track, 12 6-ton gasoline locomotives, 216 Lakewood road cars complete with batch boxes and cement compartments, 8 double truck cars, 4 finishing machines and sub-graders, 2 bulk cement handling plants, each having a capacity of 900 barrels per day, 8 scarifiers and 1 clam-shell bucket.

EDITORIALS

PROGRESS IN SOLVING THE SUB-GRADE PROBLEM

Recently it was our privilege to listen to such a concise statement of the sub-grade question that we were tempted to conclude that the solution of this vexatious problem will soon be realized, for it has been our observation that once a problem can be stated in brief but detailed terms the engineer is not long in solving it. But, on second thought, one must recognize this problem as one involving many variables and very few known quantities. Much dependence must be placed on empiricism as well as on analysis of local physical conditions. In other words, the solution must be reached through the process of trial and error so familiar to engineers. While great progress is being made, indeed wonderfully gratifying progress, it is only reasonable and fair to conclude that a considerable period of time must pass before the engineer will be justified in feeling that he has solved the greatest of all highway engineering problems, namely, that pertaining to the sub-grade.

We are calling attention to the inevitable delay in reaching the final solution of this problem for the reason that suggestions are occasionally made that the highway construction program be suspended awaiting that event. It would be distinctly unfortunate to adopt such a suggestion for there are many other unsolved highway problems having to do with such considerations as the method of financing construction and maintenance, the regulation of the speed and weight of vehicles, the design of motor trucks with special reference to impact on the highway, and even the innocent appearing question of the width of the paved roadway.

We do not wish to minimize the importance of the sub-grade problem; that is farthest from our intent. But let us not overemphasize its importance for there are other, and will continue to be other, problems for the highway engineer to solve. These problems will all be solved in time, no doubt, and then new difficulties will present themselves in highway work, just as in every other class of work.

The sub-grade problem cannot be worked out entirely on the scratch pad or in the laboratory. Analytical and small scale experimental studies are necessary but not sufficient; they must be supplemented with a great variety of full scale operations in the field. To postpone construction would not aid greatly in solving the problem; it would only postpone the solution and would continue to deprive the public of the use of urgently needed highways. The engineer will gain mastery of the sub-grade only after much study of its many phases and factors. We trust that suggestions of delay in construction will be dropped as ill considered, unwise, and dangerous to the cause of better roads.

TAKING UP THE INDUSTRIAL SLACK

Unemployment grows with the subsidence of the war-time boom in industry. Very frequently one notes news articles to the effect that public officials are being requested to provide work for the unemployed men who are being dropped from industrial payrolls. From a general condition of labor shortage there has been a rapid transition to a state of unemployment which is assuming considerable proportions in those regions where industry has been most affected.

This condition was anticipated by those who have made much study of industrial cycles. Next in order should come a period of great activity in the construction of public works of all sorts. Such projects will provide employment for all labor not needed elsewhere and it is believed that all cities and counties who make any pretense at looking after the welfare of the laboring classes will start construction work as soon as possible so as to provide useful and profitable employment for wage earners.

That there is a tremendous accumulation of public works projects, which have been piling up for several years, everybody knows. If there is a city or county, however, in which improvement projects have been totally neglected, now is the time to get them started. In general, the present winter should be utilized in bringing projects up through the political, legal and financial stages so that, with the return of construction weather, construction may proceed at once without the loss of more time.

We trust that inexperienced public officials, as well as business men seeking opportunities in the construction field, will quickly appreciate that a great construction season impends and that they will plan accordingly. Nothing is to be gained, but much is to be lost, by waiting to see what will happen. Many times in the past construction has been quiet during industrial booms and always with the oncoming of a depression in industry, however slight, there has been a corresponding quickening of all constructional activities. We find no pleasure in calling attention to present industrial conditions and do so only by way of pointing out that the construction man is about to have his inning.

Resurfacing Worn Out Macadam Pavement at Dubuque, Iowa

Using Bituminous Concrete Binder to Shape Up Old Pavements

By Hugh W. Skidmore, of Chicago Paving Laboratory, Consulting and Inspecting Engineer, 160 N. Wells St., Chicago, Ill.

The preservation of existing pavements has always been worthy of serious consideration. Judicious treatment of old pavements resulted in remarkable savings even in the days of low prices; hence, with the advent of present day construction costs, the value of the assets existing in old pavements, has increased to such an extent as to attract the attention of engineers and public officials generally. Many have been surprised at the results obtained and the number of converts to the saving of old pavements has steadily increased.

Reclaiming Grand View Ave., Dubuque

The redemption of a worn out macadam pavement, which during a short life had given most unsatisfactory service, has recently been accomplished at Dubuque in the case of Grand View Ave. The condition of this pavement prior to resurfacing was such that more or less skepticism as to its value as a foundation was to be expected. While the opinion of interested property owners may be, and very often is adverse to a proposed improvement, such objections are usually the result of an erroneous premise, and should not receive too serious consideration from the engineer; nevertheless, confidence in the engineer's judgment, on the part of the taxpayers he serves, is gratifying. It was pleasing to note the increasing satisfaction among the residents along the street as the work progressed.

The Methods Employed

It is thought that the methods employed in resurfacing this pavement are in accord with sound engineering principles and that a number of the conditions encountered are sufficiently common to work of this nature to render an account of some interest. A few months prior to awarding the contract, late in the summer of 1919, a thorough examination of the old pavement was made by the city engineers and the writer. Conditions which were found to exist were such as to make desirable certain changes in the original plan of procedure as adopted by the City Council. The original program, which called for 2¼ ins. of bitulithic wearing surface, made no provision for treatment of recently excavated trenches or poorly drained portions of the subgrade and did not contemplate any means of building up depressions in the old pavement. The contract as finally awarded, however, provided for the use of bituminous concrete binder, coarse mixture, with special treatment of trenches and doubtful portions of the subgrade as directed by the engineer.

Grand View Ave. serves as one of the principal in-and-out thoroughfares of the city, so that given a good pavement surface, it might be expected to attract considerable motor traffic, with pleasure cars predominating. The street was laid out approximately along the top of a ridge with a central parkway and two drives. The topography is such that there is a considerable natural fall longitudinally of the pavement in the direction of the open country. The portion resurfaced is about 1 1/3 miles in length and contains some thirty odd thousand square yards.

Poor Drainage Chief Cause of Former Failures

With the soil conditions which prevail generally throughout the residence portions of the city, good natural drainage might be expected along Grand View Ave., particularly in view of the slope in both directions from the pavement for the greater portion of its length. It was found, however, that probably the chief cause of rapid deterioration of the old macadam was due to lack of adequate drainage. No doubt this defect was largely accountable to the fact that when the pavement was originally laid out, proper advantage was not taken of the natural lay of the land and apparently the question of drainage appeared as an insignificant item to those responsible for the design. Aside from the fact that no storm sewer exists in the street, two primary causes contributed to poor drainage of both surface and sub-surface: first, the impervious clay subsoil; second, extremely flat pavement sections with no provision for frequent diversion of surface water, resulting in the flooding of long stretches.

Owing to the peculiar topography, much of the adjacent property is unsuitable for dwellings, consequently there is considerable distance between cross streets. At the upper end, a Y-shaped intersection is formed by the convergence of two lesser streets with Grand View Ave., and it so happens that both of these converging streets deliver an enormous volume of storm water into this intersection. It was found that there were no catch basins in this intersection and that the pavement was designed with a "dish" so that all of the water arriving at this point was discharged into Grand View Ave. The natural effect of poor design, therefore, was to maintain a saturated subsoil and macadam structure during a considerable portion of the year.

Trenches Facilitate Examination

An excellent opportunity for examining the subsoil and road metal was provided by the excavation of plumbers' ditches a few months prior to construction. Installation of water and gas services in front of all vacant property, while it provided this opportunity for an examination of soil and structural conditions, at the same time made necessary extra precautions in protecting the trenches

against future settlement. As previously mentioned, the soil was found to be impervious clay. A thorough examination of the macadam structure revealed the fact that the pavement had been originally laid on a Telford base, which had been resurfaced with macadam only a few years prior to this examination, and that as a general rule, the entire central portion of each drive had little, and oftentimes practically no surfacing material left, thus exposing to traffic the Telford foundation. More or less concentrated traffic along the central portion of each drive had resulted in reducing an extremely flat pavement section to a very irregular concave surface. It was at once apparent upon examination that there were many portions of the pavement which would require several inches of new material in order to provide the proper elevation and crown. It was also found that there were a number of sections of the subgrade which were very unstable during wet weather.

Observation following heavy rains revealed mud working up through the base in several places. Inspection of these areas was made with a view to determining whether or not the soggy condition was primarily due to poor under-drainage, and if poor surface drainage was found to be the chief source of the trouble, whether or not it would be safe to assume that this condition would be relieved upon building up the structure to proper grade and contour and providing a water-tight surface. In several instances it was found that excavation of the unstable material was desirable and that under-drainage would be necessary. Examination of the intersections indicated that all of them would have to be reshaped in order to divert storm water from Grand View Ave. instead of carrying it along the pavement as had theretofore been done.

VIEWS SHOWING THE RESURFACING OF AN OLD MACADAM PAVEMENT ON GRAND VIEW AVENUE, DUBUQUE, IOWA.
Left: Binder Course Ready for Top. Center: After Resurfacing. Right: A Badly Worn and Almost Impassable Roadway Converted into a Smooth and Serviceable Traffic Floor.

Some New Curbing Necessary

The old stone curb around the central parkway was found to be badly out of line and generally in poor condition; the combined curb and gutter along the outer edges was found to be in fair condition. However, owing to the elevation of the macadam adjoining the gutter, and in view of the proposed general raise in grade of the pavement, it would be necessary either to reconstruct the gutters or carry the wearing surface over their tops to the face of the curb. (The latter was recommended and the former was adopted by the Council.) As is often the case in resurfacing old pavements, it was thought that some alteration of the curb and gutter grades would improve the general drainage ability of the pavement. However, as is likewise usually the case, radical changes of this nature were to be avoided as far as possible in order to preserve existing improvements, such as sidewalks, carriage walks, intersecting curbs, parkways, etc.

Conclusions and Recommendations Following Examination of Old Pavement

In summing up the evidence brought out by careful examination of the old pavement, with respect to such local conditions as had contributed to failure in the past and were likely to have a similar effect in the failure, it was readily seen that a well defined and carefully executed construction program was imperative; one which would include such essential items as (1) excavating and refilling, with stone or gravel, such portions of the subgrade as were found to be unstable, and the use of tile drains where necessary; (2) a general raising of the entire pavement surface to provide sufficient longitudinal and cross fall to prevent any possible detention of surface water, this to be effected by the employment of bituminous concrete binder over practically the entire surface of the old road-bed, with the additional use of broken stone, thoroughly tamped and rolled, in some of the more extensive areas which were found to be several inches below the desired grade; (3) the employment of extra precautions in backfilling trenches so as to provide a uniformly unyielding subgrade, the accomplishment of which would require filling with stone or gravel in layers not to exceed 1 ft. in depth, with thorough tamping and puddling and, finally, if any trenches revealed signs of weakness under the final rolling of the subgrade, they should be reinforced with concrete flat arches having a bearing on solid earth entirely around the opening; (4) scarifying or cutting into the old metal was not to be permitted under any circumstances, it being deemed imperative to preserve in a compact condition the original pavement, and if necessary, to accomplish this the grade in general would be raised sufficiently to avoid the necessity of cutting down even small areas; (5) raising the gutter grade over the entire job in order to provide for thickness of the wearing surface; (6) building a concrete curb around the central parkway; (7) providing transverse fall of not less than 1/3 in. to the foot and raising intersections in order to turn surface water into cross streets; (8) thoroughly cleaning the surface of the old pavement by means of a rotary street broom prior to the application of binder or crushed stone; and last, but not least, (9) the employment of rigid inspection by experienced men.

Construction Progress Delayed by Wet Weather

The work was done in accordance with the recommendations with the one exception mentioned above;

that is, new concrete gutters were laid instead of carrying the asphaltic concrete top over the old gutters. Some of the new gutter was broken down by traffic and contractor's rollers prior to laying the wearing surace. Final examination of the work indicated that forming gutters with the asphalt mixture would have been more satisfactory.

Owing to the condition of the old pavement, it was highly desirable to carry on the work during dry weather insofar as possible. Unfortunately the contract was not let until late in the season, and construction of the pavement was delayed until late October, 1919. During the late summer there had been considerable rainfall, so with construction starting as late as it did, it was anticipated that a more or less saturated subgrade would be encountered. For this reason, the city officials were warned against the dangers attending work of this nature during a period when the subgrade would have no opportunity to dry out between rains.

However, the contractor was anxious to complete the first section of the contract (about 10,000 sq. yds.) before cold weather, so the work went forward, about 5,000 sq. yds. being laid before it became necessary to order the work stopped on account of wet subgrade, following several days of bad weather. The work which was laid in 1919 was rather irregular as to surface and in this fell short of expectation. Upon examination in the early spring, there were no signs of subsidence, so it was thought that the appearance of the pavement would

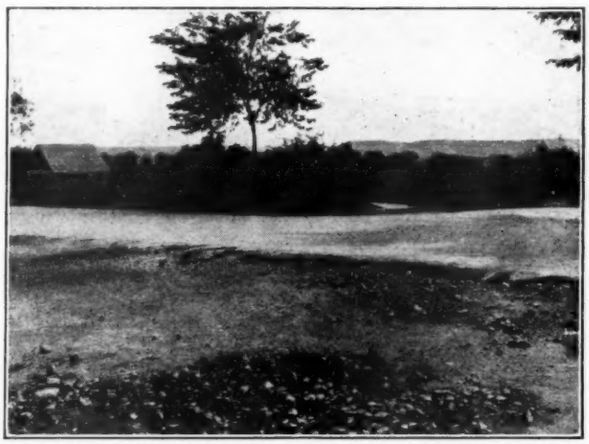
RESURFACING WORN OUT MACADAM ON GRAND VIEW AVE., DUBUQUE, IOWA.

To Avoid Interrupting Traffic one Driveway was Laid Complete Before Commencing Work on the Other Drive. Workmen are Spreading Seal Coat Over Bitulithic Wearing Surface. Uncovered Binder and Prepared Subgrade Shown in Foreground.

improve under warm weather traffic. Later investigation proved this assumption to be correct, although at the time of final inspection there was a marked difference between the 1919 and 1920 work so far as surface was concerned.

Work was resumed the following spring as soon as weather conditions would permit. The effect of dry weather was very apparent in the finished work; all of the pavement laid in 1920 presented an unusually smooth and regular surface, and the quality was excellent in all stages of construction. None of the backfilled trenches or refilled subgrade areas evidenced the least signs of subsidence under a 15-ton, 3-wheeled roller.

The binder average 1½ ins. in depth for the entire job and 1.8 ins. for 19,000 sq. yds. Actually it was as much as 3 ins. thick in places, while in a few small areas it was not necessary to lay any binder at all. The total thickness of bituminous material was 3¾ ins. on the average over the whole job, with an average thickness of 4.05 ins. over approximately two-thirds of the total yardage. Inasmuch as the old pavement was generally in such poor condition, it possessed only limited value as a



VIEW OF GRAND AVE., DUBUQUE, AT A POINT ON TOP OF A RIDGE.

View Shows Loose Stone in Depressions of an Intersection Prior to Rolling and Indicates that Pavement has been Raised Several Inches to Provide Proper Fall.

foundation, but might well be considered in the light of an artificial subgrade possessing more desirable qualities than the average natural subgrade, inasmuch as it was thoroughly compacted and thereby was given increased structural strength and greater shock absorbing ability than would ordinarily be the case with an earth subgrade. In addition to these virtues, the presence of the macadam immediately beneath the bituminous structure would also have a tendency to facilitate drainage. Therefore, although the total thickness of pavement is less than would be designed for bituminous base construction to meet the traffic and soil conditions which prevail in this instance; nevertheless, it seems only logical to classify this resurfacing work under the head of asphaltic concrete base laid upon a somewhat superior artificial subgrade.

For shaping up an old pavement, whether brick, block, macadam or gravel, there is no material which lends itself so readily to the purpose as does bituminous concrete binder.

Resurfacing a Good Investment

It is thought that this and other similar work in Dubuque during the past two years has not only been the means of converting old, worn out and almost useless roadways into substantial pavements of pleasing appearance, excellent riding qualities and with potential lives of long and useful service at a minimum maintenance expense, but also represents a very handsome saving to the taxpayers in the way of initial cost.

THE COMBINED-TYPE SEWAGE SETTLING TANK

To the Editor:—Referring to Mr. W. G. Kirchoffer's article in MUNICIPAL AND COUNTY ENGINEERING for

March, 1920, entitled "Operating Experiences with Imhoff Sewage Tanks," the design there described resolves itself into an upward-flow tank followed by an Imhoff unit to redeposit any matters unloaded by the primary unit. No advantage is to be gained by constructing the characteristic Imhoff sloped walls for flowing-through chambers over the Dortmund portion; in fact, the increased velocity of flow at the slots would tend to detract from the efficiency of the primary unit.

Reduced to its lowest terms, this in an upward-flow tank followed by an Imhoff trap tank. It is obvious that a horizontal-flow, single-story tank, may be used for the primary unit in place of the Dortmund feature, though not, in the experience of the writer, with equally good results. An important feature of such combinations is this: The primary unit, whether in the form of a horizontal-flow, single-story, or of a Dortmund unit, will unload solids through gas disturbances. These solids, being largely gas-lifted sludge, will not redeposit in the Imhoff unit unless the entrained gases are first liberated. For this purpose I have used a splash board at the entrance to the Imhoff unit, with a drop of 8 ins. or so, which provides a vigorous agitation, sufficient to release the entrained gases and permit solids unloaded by the primary unit to settle in the secondary.

The foregoing combination was suggested by the writer in an article in the Engineering Record in 1916 or 1917, with an illustrative cut. Following experiments at a test plant at the factory of the Agasote Millboard Co., in Trenton, N. J., in 1917, I installed an institutional plant at the Valeria Home, Croton-on-Hudson, N. Y., in 1919, which contained these features. The plant is most successful.

It will be apparent to the reader that a large municipal plant could be constructed in the form of a number of primary units, the combined effluents of which would be passed through a single short period Imhoff unit, with provision for gas liberation at its inlet.

To secure the best results in the primary unit, the influent should be introduced in such a manner that it will pass continuously upward through the sludge accumulations. In this manner a "colloidor" is secured, wherein the sewage is brought into prolonged and intimate contact with the multitudinous surfaces of the sludge particles, which act as colloidor surfaces. In this way a high degree of clarification is secured. Contrary to expectation, the writer has not found this to materially increase the amount of matter in solution.

When using this design in my practice, I have referred to it as a combined-type tank.

Very truly yours,

WALDO S. COULTER,
Consulting Engineer,
Sept. 24, 1920 114 Liberty St., New York, N. Y.

(The foregoing letter was brought to the attention of Mr. Kirchoffer and he has, on our invitation, submitted the following comments on the points brought out by Mr. Coulter. This is an important and timely topic for consideration and we shall be pleased to extend the discussion at our readers' pleasure.—Editor).

To the Editor:—I have read Mr. Coulter's discussion of his "Combined Type Tank" with much interest. The fact that he, as well as many others, have found it advisable to modify the Imhoff tank, more thoroughly convinces me that my own designs are an advancement in the art of sewage disposal. It could hardly be expected that when thousands of engineers, chemists, bacteriologists and others of scientific training are working on the art of sewage disposal that two or more should not be thinking and working along similar lines, in fact, some may have exactly duplicated the work of others.

It is not at all surprising that out of some dozen or more prominent engineers, editors and heads of health departments, that have expressed their views on my new form of tank, that there should not be at least one, such as Mr. Coulter, whose views might differ from mine or who might claim to have been the real originator of the new type of sewage tank. It is the same old story of "I told you so." Many persons have bright new ideas, some good, some bad, who never have the nerve or fortitude to put them before the public for discussion or use.

I recall that some nineteen years ago I conceived the idea of making a profile of a road mechanically by attaching a mechanism to a wheel revolving along the surface of the road. I never made use of it, but I have since learned that such an instrument is being manufactured in Detroit, Mich. Should I now claim to be the inventor of the mechanical profiler?

A friend of mine recently wrote me that soon after he was out of school, about 20 years ago, he conceived an idea for the purification of sewage by the use of compressed air, but he did not put it into practice. Therefore, is he the inventor or discoverer of activated sludge? (He laughs at the suggestion.) I recall very well seeing the illustration of the tank to which Mr. Coulter refers. I claim that my new tank which I have named "Kirdorthoff" is in no sense a duplicate or copy of Mr. Coulter's tank. I claim that the very feature which he so emphatically denounces in the first paragraph of his discussion is the leading feature which makes this new tank an advantage, in certain cases, over older types of tanks. I do not claim that this feature is essential in all cases. A sewage which is old on arrival at the disposal works, and especially one that has been more or less digested by pumping or other violent agitation, would no doubt be treated equally well by separate sludge digestion tanks or possibly by a plain Imhoff tank. The Kirdorthoff tank is particularly adapted to fresh sewages containing greasy matters such as will be found in thousands of our small cities and villages. The very slot which Mr. Coulter condemns really acts to prevent the gas lifted sludge and greasy matters from entering the upper chamber and flowing away with the effluent, which is a common fault with every type of tank of which I am familiar. I claim that a tank not so trapped with hoppers and slots in the primary chamber, and my experience bears me out in this, will in time discharge gas lifted and greasy sludge to the secondary chamber.

In fact I consider the primary chamber with its slot and upward flow more essential to the proper treatment of the sewage than is the second chamber which Mr. Coulter says is no more than a plain Imhoff tank.

I cannot agree with Mr. Coulter that plain septic tanks or possibly some other type giving similar results will be beneficial or advisable to use for preliminary treatment ahead of an Imhoff Tank. I have experimented with large sized separate sludge digestion tanks and plain sedimentation tanks for months at a time. All of these give good results for a period of 6 to 8 weeks, but after a septic condition becomes general throughout the mass of

retained sludge, the effluent is no longer clear or free from gas lifted sludge particles. What I have had to say, in answer to Mr. Coulter's discussion of the "Combined Type" tank, is based not upon a theory or a "hunch" that I have received or devised, but upon actual experience covering a period of several years.

I also might add, for the benefit of those who wish to make use of my contribution to the art, that this type of tank is not as completely automatic as the inventor of the septic tank unfortunately led us to believe his tank to be. If the sludge is not removed from the sludge digestion chamber at intervals, if the surface is not freed of any scum and the slopes of the hoppers cleaned occasionally, difficulties will arise sooner or later with this as with all other types of tanks, but under proper care and applied to the right sewage in a proper design, I claim that it is the best solution for tank treatment that I have found.

What we wish to do is to place the solids in the bottom of a tank where they can be digested; why wait for gravity to draw them down? It seems to me that the logical thing to do is to place them there at once by having the inlet at the bottom rather than at the top of the tank. We wish to keep gas lifted and similar sludge and scum from flowing out with effluent. Therefore the logical thing to do is to provide means in the tank so that these particles can rise to the surface of the liquid where they can free themselves from gas and at the same time be drawn into the current of the effluent to a minimum degree.

Mr. Coulter would liberate the gas by means of a water fall at junction of tanks. This may aid in the liberation of gas but my experience would point to the conclusion that it would also tend to divide the particles of sludge into smaler units and possibly beat some of them into a colloidal state, which would be difficult to break up in the short period allotted to tank treatment.

In conclusion I wish to express the opinion that we have only "scratched the surface" of the art of sewage treatment; there is a vast amount of work to be done yet before the last word can be said on the subject. It is easy to lead a horse to water, but few there are that can make him drink. It is easy for the inexperienced to design disposal tanks, but it generally takes an experienced operator to make them work.

Very truly yours,

W. G. Kirchoffer,
Consulting Engineer,
22 N. Carroll St., Madison, Wis.

Nov. 8, 1920.

LEGISLATION AFFECTING MUNICIPAL ENGINEERING

By A. W. Consoer, Manager, Consoer Engineering Co., 1654 Monadnock Block, Chicago, Ill.

Municipal improvements have always afforded a large field of work to engineers in private practice and to engineers in the public service. Yet it is surprising to note to what a slight extent the interests of the public, and of engineers engaged in municipal work, are protected by legislation which will prevent the construction of public works unless the proposed improvements have been designed by competent engineers and are constructed under able engineering supervision. Some progress in correcting this condition has been made in certain states, but engineers as a class have ever been reluctant to engage in lobbying or to use other methods for securing the enactment of remedial legislation. Because of the failure of engineers as a class to secure the requisite protective legislation instances of mal-practice in municipal engineering are found in many cities and villages.

State Regulation is Efficacious

While the administration of the Department of Public Works in many cities leaves much to be desired, the situation is particularly deplorable in some of the smaller municipalities. In some states the statutes require that plans for the installation of municipal water supplies, sewer systems, water purification and sewage disposal plants must be submitted for approval to some State Department, usually the State Board of Health, before such works can be installed. In many states no such requirement is made; in some the matter of securing such approval is optional, and in almost all states extensions and changes in existing municipal improvements are attempted without state supervision. Not all municipal engineers will agree that state regulation of municipal engineering is desirable, but that it is efficacious in many cases cannot be denied.

Fortunately the laws for the licensing of engineers, which have been passed in several states and are being proposed in others, will help to improve conditions in the field of municipal improvements. To be most effective in correcting abuses in public work, a license law should provide that no municipality can undertake the construction of any improvement of appreciable size except under the supervision of a licensed engineer.

Engineering Council's Model Law

Engineering Council's recommended model law for the registration of professional engineers, architects and land surveyors provides that one year after the act goes into effect neither the state nor any political subdivision shall engage in public work involving professional engineering or architecture for which the plans, specifications and estimates have not been made by, and the construction and maintenance supervised by, a registered professional engineer or a registered architect; provided the contemplated expenditure for the completed project exceeds $2,000. When a law similar to this is on the statute books of every state many of the disheartening features of municipal practice will be eliminated.

The license laws of Florida, Michigan, New York and Wyoming have specific clauses similar to the one recommended for public work by Engineering Council. The Idaho law has a clause concerning the filing of plans by municipal authorities which is intended to accomplish the same results as the clause quoted from the model law. In one state which has a license law that contains no clause referring specifically to public work the Attorney-General has ruled that no political subdivision of the state can legally employ any engineer and surveyor who is not licensed. The practice of municipal engineering will be bettered by the adoption of a uniform law in all states with a clause referring specifically to public work.

In many municipalities improvements of considerable importance are often carried out without engineering advice, and sometimes the class of work produced by the city engineer furnishes a powerful appeal for some kind of state supervision. That this exercise of "home rule" in engineering matters leads to some ill-considered under-

takings on the part of some municipal officials is a fact that is well known to every engineer.

Some Examples of Bad Municipal Engineering

Instances of "rule of thumb" municipal engineering and bad practice have come to the writer's attention recently which illustrate the evils of the administration of public improvements as it exists in many cities and villages.

A certain village wished to pave a system of streets, and the Village Board assured the engineer that their sewer system was "all in." Upon investigation it was found that a sewer system had been built piece-meal. Some of the pipe was standard vitrified pipe and some was drain tile. The system, comprising about three miles of sewers, included only four manholes. No records of the locations, sizes and grades of the various sewers had been kept. Much of the work had been done without having any grades set, and none of the work had been inspected during construction.

In another city the writer witnessed recently the construction of a comprehensive system of paving where the storm water inlets are all being connected to an existing system of tile drains, the largest of which is reported to be 8-in. in diameter, and all of which is on rather flat grades. In this same city concrete for the paving was being mixed from 10 to 20 seconds on the day of the writer's visit, and the inspector was exultant about the yardage the contractor was laying each day.

In a city which has a population of 8,000, has many industries, and has considerable motor truck traffic, the standard type of pavement has been and still is vitrified brick on a cinder foundation. An argument in favor of this type of construction was advanced by the mayor. He stated that because the sewer and water systems were in bad condition it was often necessary to dig up the pipes, and so they had to use a pavement which could be taken up with little expense whenever necessary.

Another instance that will bring a smile to the lips of many hydraulic engineers concerns a village which went ahead with the development of a deep well water supply after refusing to engage a consulting engineer to direct the work. The board members could not understand why the new well had failed to show a trace of water down to 500 ft., while the old well which was nearby was only 400 ft. deep and was yielding 150 gal. per minute. They were told that possibly the supply of water had been cased off by the well-driller. They were then ready enough to avail themselves of the services of a consulting engineer.

The writer knows of several recent instances where paving systems were constructed without first installing all sewer and water connections into vacant property. In many small municipalities it is not at all uncommon to find a system of sanitary sewers being used to carry storm water as well. Municipalities often purchase pumping equipment solely upon the representations of machinery salesmen. Many cities and villages are so partial to the use of 4-in. pipes in their water distribution systems that, as a result, provision for adequate fire streams is not made. It is usually found in the smaller towns that complete records of the underground work as actually installed are not available.

A city of 60,000 inhabitants recently constructed a large reinforced concrete bridge. The city did not retain a bridge engineer to prepare plans and specifications, but invited contractors to make proposals based on designs to be furnished by themselves. No compensation was given unsuccessful bidders for the cost of preparing designs, and the plans of the successful bidder were not checked by a competent engineer.

These examples of public works constructed without proper engineering supervision are so numerous that they should make a strong appeal to the various sectional and local engineering societies, and to engineers individually, to promote the passage of helpful state legislation which will correct the abuses inherent in municipal affairs in many places under existing statutes.

Recommendations on Legislation

License laws for engineers to be introduced at the coming sessions of the various legislatures can include provisions making it illegal to expend funds for municipal or county improvements which are not designed and built under the supervision of licensed engineers. License laws already passed can be amended to include these same provisions if they are not now included in the law.

Supervisory powers of State Boards of Health or other State Bureaus over the construction of water supply and sewerage works can be established or strengthened. It must be recognized that any new engineer's license law will admit to private practice or municipal service many men who are not fully competent to design and supervise the construction of municipal improvements; and to direct the activities of this class, state supervision is desirable, in the writer's opinion, for the present at least.

In many states the laws applicable to the construction of public improvements by special assessment can be much improved; and engineers engaged in municipal work can interest themselves actively in securing the enactment of new Local Improvement Acts. Features in the existing laws which cause considerable delay and uncertainty in the construction of local improvements by special assessment should be eliminated. In many states the Local Improvement Acts foster the evils of the contingent fee, which has always been the cause of much inferior work in municipal engineering.

What is true of present legislation for constructing municipal improvements is also true in many cases of the laws applicable to the organization of drainage and levee districts. Engineers engaged in drainage work and those doing municipal work can co-operate in efforts to amend or change the laws governing their respective activities. To do so will encourage work of this kind and will protect the interests of the public and of the engineers engaged in these classes of work.

The activities of municipal engineers have been seriously curtailed in recent years by a serious lack of revenue in many municipalities. Frequently funds have not been available to engage engineers to undertake investigations of much needed improvements. In many places the limit for bonded indebtedness fixed by statute is so low as to hinder or block the proper development of a city plan. While the railroads, industrial plants and labor have been able to secure increased revenue, cities and villages are often struggling along today with a pre-war income. The result is that public works which are urgently needed and earnestly desired by urban populations cannot be started until legislation is passed

which will grant to the municipalities revenue sufficient for their needs.

There is, then, a field of work for engineers in securing remedial legislation which will be of vital importance at the coming sessions of the state legislatures. It is work that should make a special appeal to local and sectional engineering societies. The national engineering societies have already commenced their campaigns for the uniform license law in all states, and will surely cooperate in securing other legislation which will increase the prestige of municipal engineers. The municipal engineer can by his individual efforts assist very materially in placing his branch of the profession on a cleaner and saner basis.

SPECIFICATIONS FOR ASPHALT PAVING

The Asphalt Association, 25 West 43rd Street, New York, has ready for circulation in printed form the following typical specifications prepared by its Technical Committee which is composed of highway engineers and specialists. In the preparation of these specifications special attention has been paid to form and arrangement with the idea of making them definite, concise and free from ambiguities. The printed specifications are on single fold sheets of the size adopted by the U. S. Bureau of Public Roads, most of the State Highway Commissions, and many municipalities.

Printed Specifications

A-1 Asphalt Macadam Surface Course.
A-2 Asphaltic Concrete Surface Course. (Coarse Graded Aggregate Type).
A-3 Asphaltic Concrete Surface Course. (Fine Graded Aggregate Type).
A-4 Sheet Asphalt Binder and Surface Courses.
B-7 Asphaltic Base (Asphalt Macadam Type).

Mimeographed Specifications

A limited number of the following specifications in mimeographed form may also be obtained upon request:

A-5 Asphaltic Concrete Binder and Surface Courses.
B-1 Gravel Base.
8-2 Macadam Base.
B-3 Reconstruction of Old Macadam to Serve as Base Course.
B-4 Telford Base.
B-5 Portland Cement Concrete Base.
B-6 Truing Up Old Pavements to Serve as Base Course.
C-1 Preparation of Subgrade.
C-2 Sub-Base.
C-3 Shoulders, Headers, Curbs and Gutters.

Specifications for Asphaltic Base (Asphaltic Concrete Type) will be available for distribution in the near future.

How Specifications Were Prepared

During the preparation of these specifications the committee had before it the specifications of every State Highway Department in the United States, as well as those of a large number of the principal counties and cities of the U. S. Bureau of Public Roads. The opinions of many prominent highway engineers were obtained and digested. The committee, with Mr. Prevost Hubbard, formerly Chief of the Division of Tests and Research of the U. S. Bureau of Public Roads as chairman, was composed of engineers having long practical experience upon highway and pavement construction and design. In order to make them applicable to varying conditions throughout the United States, each printed specification is accompanied by a notice to engineers which will assist the engineer in modifying it if necessary to meet his particular requirements.

Some Fundamental Features

A few of the fundamental features of the specifications are as follows:

A-1 Asphalt Macadam Surface Course.

A minimum thickness of 2½ ins. utilizing a coarse aggregate of 1½ to 2½ ins. crushed stone and asphalt cement of from 80 to 150 penetration are recommended. The limits of penetration of the asphalt cement are to be specified by the engineer within a ten point range if below 90 and within a 30 point range if over 90 penetration.

A-2 Asphaltic Concrete Surface Course. (Coarse Graded Aggregate Type).

A finished thickness of 2 ins. of asphaltic concrete composed of coarse aggregate 95 per cent. of which will pass a 1¼-in. screen, fine aggregate, 4 to 6 per cent. of filler, and 5 to 8 per cent. of asphalt of from 50 to 70 penetration (10 point range fixed by engineer) are the outstanding features.

A-3 Asphaltic Concrete Surface Course. (Fine Graded Aggregate).

A finished thickness of 2 ins, with coarse aggregate 95 per cent. of which passed a ½-in. screen, sand, 7 to 11 per cent. of filler, and 7.5 to 9.5 per cent. of asphalt with a penetration of 50 to 70 (10 point range fixed by engineer) are recommended.

A-4 Sheet Asphalt Binder and Surface Course.

Binder and surface courses each having a thickness of 1½ ins., binder course to have 60 to 80 per cent. coarse aggregate, sand, and 4 to 6 per cent. of bitumen, the asphalt cement for both courses to have a penetration of from 30 to 6 with a ten point range fixed by engineer. The surface course mixture is as follows:

Passing 10 mesh, retained on 40 mesh..... 10 to 40%
Passing 40 mesh, retained on 80 mesh..... 22 to 45%
Passing 80 mesh, retained on 200 mesh..... 12 to 30%
Passing 200 mesh ..... 10 to 20%
Bitumen .....9.5 to 12%

B-7 Asphalt Base (Asphalt Macadam Type).

To consist of two courses—the first to have a thickness of 3½ ins. and the second 2½ ins., coarse aggregate for the first course to consist of 2½ to 3½-in. stone and for the second course 1¼ to 2½-in. stone, asphalt cement to have penetration of from 80 to 150 (fixed within a 10 point range if less than 90 and a 30 point range if over 90, by engineer), one application of asphalt at the rate of 1.25 to 1.5 gals. per sq. yd. to be made upon each course, and the second course covered with a thin layer of ¾ to 1¼-in. stone.

A-5 Asphaltic Concrete Binder and Surface Courses.

This specification provides for a 1½-in. course of fine graded aggregate asphaltic concrete wearing course as specified under A-3 laid over a 1½-in. binder course as specified under A-4.

B-1 Gravel Base.

To consist of two courses each not less than 4 ins. in thickness after compaction, 95 per cent. of the gravel to

pass 3½-in. screen and 50 to 75 per cent. to be retained upon a ¼-in. screen.

B-2 Macadam Base.

To consist of two filled courses each not less than 3 ins. in thickness, 95 to 100 per cent. of the crushed stone to pass a 3½-in. and 0 to 15 per cent. a 2½-in. screen, 95 to 100 per cent. of the screenings to pass a ¾ or ½-in. screen and 40 to 80 per cent. a ¼-in. screen.

B-3 Reconstruction of Old Macadam to Serve as Base Course.

Provides for reconstruction of old macadam in order to secure a minimum thickness of 6 ins. after compaction.

B-4 Telford Base.

Provides for hard laid 8-in. Telford Base.

B-5 Portland Cement Concrete Base.

A mixture in the proportions of 1:3:6 with a thickness of 6 ins. is specified.

B-6 Truing Up Old Pavements to Serve as Base Course.

Provides for truing up old pavements by the use of an asphaltic concrete mixture in preparation for the application of an asphaltic wearing course.

C-1 Preparation of Sub-Grade.

(No explanation required).

C-2 Sub-Base.

Provides for a sub-base of field stone filled with smaller fragments and compacted.

C-3 Shoulders, Headers, Curbs and Gutters.

Provides for gravel, water-bound and asphalt macadam shoulders, and portland cement concrete headers, curbs, and gutters.

MAKING NEW GRANITE PAVEMENT FROM OLD BLOCKS FOR NEW ORLEANS CAR TRACKS AT SAVING OF 50 PERCENT

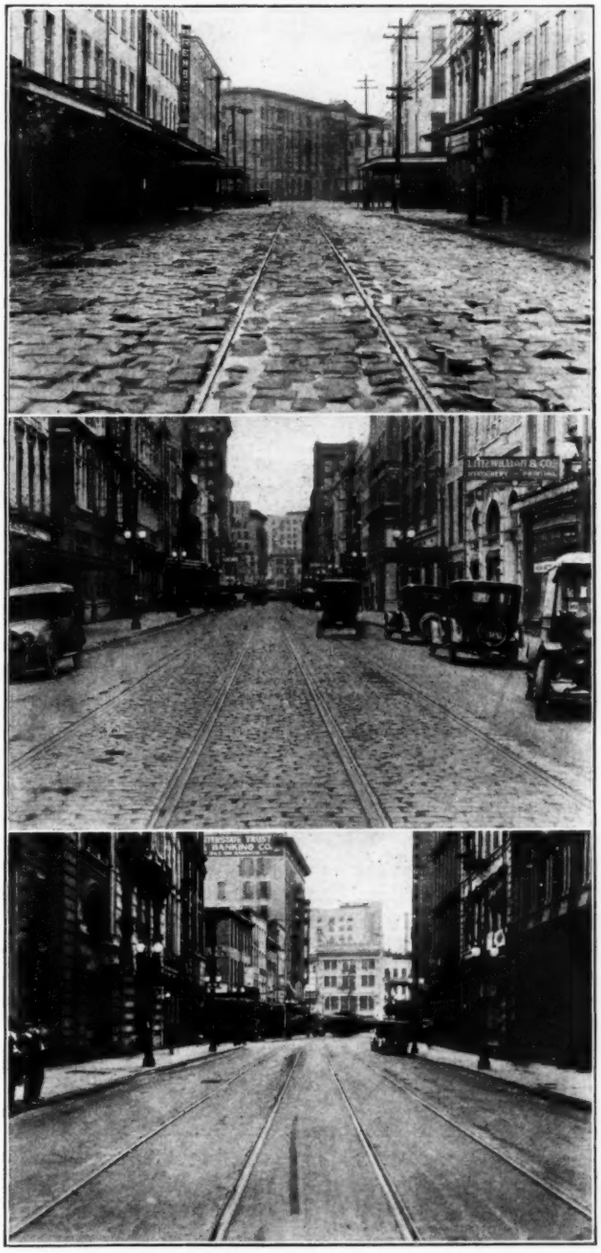
By John C. Bartley, 712 Hennen Bldg., New Orleans, La.

Memories of the fairy tale of childhood about the peddler who wandered through the streets of the Arabian city offering to exchange "new lamps for old" are revived in a piece of paving work recently completed by the New Orleans Railway and Light Co., under the direction of their chief engineer, Mr. M. V. Houlard.

In the days when this city went from cobble stone paved streets to the more enduring large square block granite roadways there was a section of the town which was adorned with blocks from the granite hills of Maine. That this granite served its purpose well and faithfully was never questioned, though it failed to come up to the present-day requirements, and with the drainage of the city and the substitution of deep, open gutters, with terra cotta pipe, there was then no need of these highly crowned roadways, so necessary in the early days of street construction, some 50 or 60 years ago. It was destined therefore to go into the discard in the march of progress, and residents along this thoroughfare, formerly the eastern boundary of the city, were not surprised to learn one day that the city fathers had decided to remove the granite and to replace it with a more expensive and modern pavement, in conformity with an elaborate program of street improvement.

When the old large blocks were removed they were split into quarter sections, approaching in size the standard 5-in. granite block, and the New Orleans Railway and Light Co. acquired these blocks, purposing to lay them in their car tracks.

The first opportunity that the company has had to use this material in rail construction recently presented itself, when the blocks were laid between the tracks along a section of Camp street up from Canal street, the city's main promenade boulevard. The result was highly satisfactory. That part of the paved roadway lying between the tracks is as pleasing to the eye as the outlying sections, from the car tracks to the sidewalks, laid with asphalt, and presents a smooth, firm surface. It is more enduring than the high priced pavement that replaced the old square granite block on the street from which



VIEWS OF OLD AND NEW GRANITE PAVEMENTS IN NEW ORLEANS USING SAME BLOCKS.

Top: Old Square Granite Block Street-Center: Ordinary Construction Between Rails with Re-cut Granite Blocks Laid at Same Time Blocks with Mastic Filler were Laid. Botton: Re-cut Blocks Laid with Asphaltic Cement and Hot Sand Filler After One Year in Service.

these blocks were removed, recalling the story of Aladdin and His Wonderful Lamp.

The old track foundation was not disturbed, except where new rails were placed, some ballasting was done and the blocks were laid in a cement sand cushion. The mastic filler was used—equal parts of hot asphaltic cement and hot sand. The asphaltic cement was heated on the job to a temperature of 360 degrees Fahrenheit, but no facilities were available for heating the sand, and it had to be heated at the local asphalt plant, at about 400 degrees Fahrenheit, before being hauled to the works. The temperature in the sand was maintained undiminished, the sand being about the same temperature when mixed with the asphaltic cement. The mixing was done in iron barrows with hoes, the mixture being sufficiently agitated to produce a uniform mix. It was then poured into the joints and a very thin coat squeegeed over the blocks—just sufficient to be sure the joints held.

There was no interruption to the running of the street cars, and but slight delay to vehicular traffic. Only one side of the street was treated at a time; as soon as the stretch was finished and sanded it was thrown open to traffic.

While the work was under way skeptics among the onlookers expressed the opinion that it would not hold, alleging that the summer heat would so soften the filler that the joints would break and the blocks would rock loose. No sign of weakness has evidenced itself in any part of the construction, despite the intense heat of the past summer.

Fig. 1 is a typical New Orleans old square granite pavement, now fast disappearing, and being replaced by modern construction and with other types of surfacing. Fig. 2 shows these old square granite blocks split up into blocks of smaller size and laid between the street car rails. Fig. 3 shows similar blocks recut from the old square granite blocks and laid on a portion of Camp street with hot asphalt and hot sand filler.

The conservation of old granite blocks by recutting them into smaller size and employing proper methods of construction has not only saved the railway company fully 50 per cent. in cost of new material, but has provided a sanitary, noiseless and smooth riding surface for automobiles and an enduring pavement for the heaviest kind of traffic.

SOME FEATURES OF HIGHWAY MAINTENANCE WORK IN PENNSYLVANIA

By George H. Biles, Assistant Commissioner, State Highway Department, State House, Harrisburg, Pa.

To maintain means to hold or keep in a particular state or condition, and this is a big problem today with our highways, due to the rapid evolution of traffic in recent years. We emerged almost over night from the era of horse-drawn traffic to the motor and, subsequently, to the heavy trucks. Idealists tell us that roads should be constructed to accommodate all forms of vehicular traffic. While we cannot help but feel there is some measure of truth in such a theory, we know that from the practical standpoint there is not enough money or resources in the country to carry out such ideals in the way that can bring relief to the situation for many years to come.

In the interim we have on our hands a vast mileage of the so-called obsolete types which must be kept up and to which must be applied the best principles of modern maintenance. At the same time, deference must be given these highways by our Legislators in fixing by statute the loads to be carried.

For example, the great State of Pennsylvania, in its main system of 10,235 miles of highways, has approximately 3,000 miles of such roadways, 6,175 miles of earth and shale roads and 1,060 miles of modern types. This network of roads must meet the universal demand for utility the year round in varying degrees, depending on the locality.

With the change in forms of traffic, there had to be a corresponding change in methods of upkeep. The sporadic maintenance of the yesterdays, when the countryside gathered at convenient intervals on the roads, when it least interfered with their private pursuits, and worked the townships for their taxes, must needs give way to more effective and intelligently directed effort.

Some conception of the volume of traffic on parts of the Pennsylvania State system of roads can be gleaned from the results of a recent traffic census taken on one of the main trunk lines, which showed 40,000 vehicles passing certain given points in 48 hours. This highway is about 380 miles in length and 27 miles of this is the macadam type of road with bituminous surface treatment.

This abnormal use of the highways, which we know is not confined to Pennsylvania alone, must be met with the best skill available if the roads are to be saved. In normal times we probably would have difficulty in justifying some of the things we are compelled to do now, but every possible obstacle and contingency that is likely to arise has to be anticipated and overcome as much in advance of taking up the actual physical operation as possible.

Use of Mechanical Devices

The shortage of labor was met by the introduction of mechanical devices and we no longer see the large road gangs along our highways, for these have been replaced with small crews with equipment adapted to the particular class of work in which they are engaged.

To illustrate this, special attachments to power road rollers have been perfected that can tear up long stretches of road surface and replace them in quick and satisfactory order with but a small organization. When quantities of crushed stone are shipped to justify it, unloading plants are installed at the siding, which handle the materials expeditiously and economically. Motor trucks with dump bodies for the most part have replaced the teams in hauling the materials to the site of the work where a small force is able to put them in place or storage.

The large forces required for spreading covering material on bituminous surface treatment work have been done away with by the adoption of mechanical spreaders drawn by small tractors and trucks, which power can be also utilized for hauling of other kinds when not so engaged.

In the maintenance of earth road sections, fleets of tractors are used to operate the road graders, permitting of the performance of this work at the proper time in the spring to obtain the best results. Light patrol trucks may be used to advantage in dragging such roads during the remainder of the season.

The rigors of winters no longer keep the traveler off the roads, for snow removal work has become a definite and established duty and here again machinery to a large extent has been introduced successfully.

Delivery of Material in Fall and Winter

Materials have been manufactured and delivered on the road through the fall and winter months for the succeeding season's work on the theory that, under such abnormal conditions through which we have passed, a ton of material on the highway was worth many times this amount in the quarry.

Value of Organization and System

A better idea can be had of what can be accomplished under such unfavorable conditions where there is organization and system from the results of the season's maintenance program for this State, shown as follows: Resurfacing, 315 miles; bituminous surface treatment, 1,400 miles; general maintenance solid surfaces, 4,000 miles, and general maintenance earth roads, 6,175 miles.

This program will involve the expenditure of approximately $7,000,000 and the employment of an average force of 4,000 men. In comparison with the year 1917, when approximately the same amount of work was accomplished, we find that in so doing an average of 6,000 men was employed, and after making due allowances, the advantage of modern methods is shown distinctly.

Engineers have been delving into the realms of the unknown and carrying on exhaustive studies and experiments to discover the elixir of life for the modern highway, in order to meet successfully the demands of present day and future traffic, and great strides have been made in the last decade.

I venture to interpose that nothing in the form of highway construction is permanent that is not permanently maintained. Maintenance is one of the neglected arts, for if there was a fraction as much science put into the methods of upkeep of highways as there is in their construction, there would be less economic waste in the country today.

The libraries for engineers are full of treatises and technical works on highway construction but an exhaustive search does not reveal much for the student of maintenance.

This is a time for prudence. There is much educational work ahead for the men who are engaged in this profession if the momentum of highway development is to be kept up.

Times are changing rapidly. The state of mind of our people is slowly but surely returning to its equilibrium. The excesses and extravagances of the recent war era are giving way to more deliberate and sound thinking and demeanor. The vast investments in highways must be protected and conserved to command public confidence and respect if we are to go on. Emergencies, some of which have passed, decreed the construction of many miles of road, which were bought at the market out of bond issues when the purchasing value of the dollar was about 40c.

As values gradually return to normal, if we neglect these highways in the interim or permit them to suffer unintelligent maintenance, I shudder to think of the disastrous effect upon the future of road development if we are called upon to replace them before the maturity of the bonds which must be paid with probably the 90 or 100c dollar, and there is little, if any, salvage from the original investment.

Maintenance Funds

Maintenance is an annual charge and should be paid out of current revenues. The fees from motor vehicle registration seem to be the most logical source from which funds should be derived. Legislation making such appropriations or authorization should be so definite and specific that not a dollar could be diverted to any other purpose. The user of the road is in full accord and a strong advocate of the policy that the money he pays for the use of the highway should go into its upkeep.

WIDTH OF ROADWAYS FOR DIFFERENT CLASSES OF STREETS

By Robert Hoffmann, Commissioner and Chief Engineer, Department of Public Service, City Hall, Cleveland, Ohio

The determination of roadway widths is not a matter susceptible of exact scientific treatment as several rather indeterminate factors enter into it. Doubtless certain rules have been used by some engineers in fixing roadway widths, which, while permitting an appearance of consistency in their work, after all, expressed only their judgment. Under similar conditions other engineers, equally capable, might not have considered such rule applicable, as their judgment of conditions differed.

Some Roadways Too Wide, Others Too Narrow

The subject of roadway widths has been widely discussed and quite fully treated by highway engineers and by writers on municipal matters. Not much that is new can be added, yet a review of the situation is doubtless warranted, especially as affected by the motor driven vehicle. There seems to exist, moreover, a demand for the standardization or classification of roadway widths, so that when certain conditions are assumed the width will be directly determined. This would, in a large way, make possible true economical roadway construction. Economy may be fostered by preventing the building of roadways of excessive widths, thereby saving construction cost, and also in assuring paved ways of ample widths, so as to prevent untimely reconstruction in order to meet the demands of traffic. Frequently one sees pavements which appear altogether too wide for the traffic using them. If any excuse for the apparent excess width existed it must have been the adoption of some arbitrary rule fixing the relation between width of roadway and the distance between property lines. Such wide roadways represent an apparently unnecessary and idle investment. The reverse condition, where roadways are too narrow to permit adequate provision for traffic, is also frequently found. This latter condition is specially manifest in roads where street railway tracks have been laid. Here again the adoption of some arbitrary relation between width of street between property lines and the paved roadway, may have been the cause of building an inadequate roadway, or perhaps the growth of traffic was under-estimated, or the building of the street railway tracks was not contemplated at the time that the pavement was designed. The correction of the difficulty, brought about by providing too small a roadway width,

involves reconstruction or widening, generally at largely increased cost, and in addition an untimely hindrance or annoyance to public travel. Extreme foresight in judging traffic conditions and the adoption of some logically thought out standards seem quite necessary in order to prevent the unsatisfactory conditions just mentioned.

Two Points of View

The determination of roadway widths may be considered from two different points of view. One is from the viewpoint of appearance, governed by rules of proportion, or by making provision for predetermined widths of sidewalk strips or for lawn and parking spaces. The other viewpoint is that of traffic accommodation.

The first viewpoint applies principally to parkways, boulevards and certain classes of residence streets, where beauty and proportion largely control the design rather than economy and utility. Making the roadway from 50 to 60 per cent. of the street width between property lines will, in many cases satisfactorily suit conditions. The design of the planting strips and lawns will, however, nearly always control the width and arrangement of the paved roadways. Even here the expected traffic should receive consideration, but its subordination to other conditions may be perfectly logical and free from criticism.

Consideration of roadway widths from the second viewpoint, that of traffic accommodation, obviously applies to the greater number of cases, and should be the prevailing point of view when considering any basis of design or the standardization of widths.

Financial Aspects

To justify the importance of the subject of roadway widths, it is only necessary to consider the financial side involved. Should the road building programs, that are now being advocated, be brought to the point of construction, it does not seem impossible that for some time to come ten thousand miles of pavement will be constructed yearly. An extra foot in roadway width involves an expenditure of from two to three thousand dollars per mile of pavement under present conditions. For this country's entire road building project, therefore, a sum of from twenty to thirty million dollars becomes annually involved in the addition or rejection of a single foot of roadway width. This represents waste if the extra foot in width is unnecessary and means ultimate economy, if the additional foot will be required by traffic.

Not only is the unproductive investment, caused by an excessive width of roadway, to be deprecated, but, even more so, is the unnecessary removal of labor and material from useful application elsewhere to be regretted. On the other hand too small a width of roadway may result in slowing down the speed of traffic, in causing accidents due to collision or by vehicles being forced off the pavements and in bringing about a general curtailment of the usefulness of the highway. This condition creates a somewhat intangible damage and monetary loss that may far offset an apparent economy in initial investment.

Amount and Character of Traffic

The amount and character of traffic bear an important relation to the width of a road. The total tonnage for a given time or the weight of individual vehicles are of comparatively little importance when fixing the width, as the controlling factors are the size of the vehicles, the speed with which they are to be driven, and the lateral space which must be provided for passing vehicles.

Passenger vehicles as a class may be assumed to have a maximum overall width of 6 ft., while trucks and vehicles, normally used for carrying freight or merchandise over highways do not generally exceed 8 ft. in width. However, there seems to be a natural tendency towards increasing the width of trucks, specially for certain classes of merchandise, which has resulted in a number of places in limiting the size of vehicles by law. So far the maximum width of 8 ft. seems to satisfy existing conditions. The speed of the vehicles affects the clearance which should be left between vehicles when meeting or passing each other. Obviously fast moving cars require a greater clearance for safety than slow ones. Passenger cars consequently should be provided with greater clearance than slow running trucks. A provision of 10 ft. in width as the allotted space for each moving vehicle seems adequate for all cases, provided the maximum width of trucks does not exceed 8 ft. This unit width is larger than was formerly assumed in roadway design but seems justifiable in the interest of safety. Many country highways, providing for two lines of vehicles, have been built narrower than the 10 ft. unit would require, and have served their purpose admirably. Such roadways have been constructed of widths varying from 12 to 18 ft. and when used principally for a moderate number of passenger vehicles have proven quite satisfactory. As the amount of traffic has increased, however, and the number of trucks using the highways has grown, it has been found necessary in many cases to widen the paved roadway in the interest of safety and the expedition of the traffic.

The length of the vehicle as it affects roadway widths is less important except in cases where the use of the vehicle requires its backing to the side of the road in order to load or unload. Many trucks are 25 ft. in length and become a determining feature if their use necessitates backing up to the curb or the side of the traveled roadway.

The kind of load to be carried may also have an influence on the practical width as frequently with light produce or other material, the load is built up so that it extends over the sides of the vehicle. Similiarly, occasional loads extend over the back of the vehicle, as in cases of building material. The frequency with which these exceptional cases occur must be considered and may form a determining feature in certain cases.

Should a roadway be restricted for the use of one line of vehicles only, then the 10 ft. unit could be somewhat reduced. In such case the width need be only such as would accommodate the wheel base with a sufficient allowance to cover the irregularities in steering or driving. Probably 8 ft. in width would suffice. Cases of this kind will seldom occur on public highways and so narrow a roadway would not be justified unless the earth at the side furnished, under normal conditions, a usable road.

On light traffic roads and where the utmost economy must be practiced the single width roadway may be justified, but generally it will be found that the minimum width of paved roadway, acceptable to traffic, must provide for two lines of vehicles, and should preferably be built 20 ft. in width. Here again this assumption can be

modified and the width reduced to as little as 16 ft. when the natural soil conditions are favorable, and admit of an occasional driving off the pavement where forced to do so by some passing vehicle.

For average conditions of traffic, the use of a 10-ft. space for each line of moving vehicles, is suggested as a unit of design. This width applies to street railway cars as well as other motor vehicles. Similarly 7½ ft. may be assumed as the required space for a row of standing vehicles, as when parked along and parallel with the sides of the road.

In fixing roadway widths upon the foregoing basis, the problem lies in assuming the probable number of lines of moving and standing vehicles which must be provided for. Considerable judgment will be required in making such an assumption. The growth of traffic is an element which must be considered and for which no exact data can be obtained. It is well known that the improving of a road by proper alignment, easy grades, and a smooth surface, invites traffic, bringing to such road a far greater number of vehicles than had previously driven over it. With the improvement of the road it will usually be found that new buildings, for homes or industrial uses, will be located along the roadway, bringing with them added traffic in trucks and passenger vehicles. Many occasions will be found for stopping vehicles and allowing them to stand along the way. Should the stopping of vehicles be sufficient to warrant it, an added width must be assumed to provide for the necessary line of standing vehicles. This constantly changing character and extent of use to which a roadway is subject will always make difficult the adoption of the assumption needed for the economical design of roadway width.

Classification for Fixing Widths

In a general way the following classifications may be suggested as a statement of roadway widths in accordance with the foregoing discussion:

(A) City Streets Having Double Street Car Tracks

1. Roadway 75 or 80 ft. in width. A roadway of such width will accommodate on each half, one line of street cars, two lines of moving traffic and one line of standing vehicles; or one line of street cars and three lines of moving traffic. In the latter case the 80-ft. width is preferable. The distance between property lines should be from 106 to 120 ft.

2. Roadway 55 or 60 ft. in width. A roadway of such width will accommodate on each half, one line of street cars, one line of moving traffic, and one line of standing vehicles, or one line of street cars and two lines of moving traffic. In the latter case the 60-ft. width is preferable. The distance between property lines should be from 80 to 100 ft.

3. Roadway 40 ft. in width. A roadway of such width will accommodate on each half one line of street cars and one line of either moving traffic or standing vehicles. The distance between property lines should be at least 60 ft.

(B) City Streets Having No Street Car Tracks

1. Roadway 40, 55 or 60 ft. in width. Same condition as for streets having street car tracks, except that line of street cars is replaced by line of moving vehicles. Absence of street car tracks will frequently permit traffic going in one direction to occupy more than half the roadway. This would be possible when traffic is periodically greater in one direction than the other.

2. Roadway 20 to 35 ft. in width. Residence streets. A roadway of such width will accommodate two to four lines of traffic under different combinations of moving and standing vehicles. The distance between property lines should be 40 to 60 ft.

(C) Highways Outside of Cities

1. Roadway 40 or 55 ft. in width. For traffic between important centers of population. A roadway of such width will accommodate four to six lines of traffic under different combinations of moving and standing vehicles.

2. Roadway 30 to 40 ft. in width. For traffic between centers of population of less importance than the foregoing. A roadway of such width will accommodate three or four lines of traffic under different combinations of moving and standing vehicles.

3. Roadway 20 to 30 ft. in width. For traffic between cities and smaller places or between important smaller cities. A roadway of such width will accommodate two or three lines of traffic under different combinations of moving and standing vehicles.

4. Roadway 16 to 20 ft. in width. Rural highways. A roadway of such width will accommodate two lines of traffic.

5. Roadways 8 to 10 ft. in width. Light country traffic where earth at side can be used to a limited extent.

(D) Streets in Small Towns and Villages

1. Same classification as in cities, except that additional width may be required for standing vehicles where business is concentrated on few streets, so as to permit parking perpendicular or at an angle to the curb. Twenty to 25 ft. for each row of standing vehicles will be desirable in this case.

The foregoing classification must of course be considered somewhat elastic and must be changed accordingly if cars are allowed to park otherwise than parallel with the curb. The question of parking cars upon public streets has an important bearing on the question of roadway widths as it also has upon the control of traffic in general. It must be decided which streets, if any, shall be used for the storage of cars. If the standing of vehicles on the streets is permitted for intervals of possibly longer than an hour, it becomes a problem of storage, and it may be necessary so to design the roadway widths that the greatest number of cars may be accommodated within a limited district. This may require provision for standing cars at an angle to the curb.

The importance of parking regulations entitles it to special consideration and it will not be further touched upon herein, except to note that the adoption of a policy in connection with the parking of vehicles must necessarily have a bearing on the proper widths of roadways.

Conclusion

In conclusion it may be said, that the width of roadways depends upon the size of vehicles, the speed at which they are driven, the lateral clearance between vehicles which should be provided, and the total number which are expected to use the road in a given time, together with their arrangement in lines or rows of traffic. Under average conditions of traffic a width of 10 ft. may

be assumed as satisfactory for each line of moving vehicles, including street cars, and 7½ ft. for each line of standing vehicles parked parallel with the roadway.

The foregoing paper by Mr. Hoffmann was presented at the 1920 annual meeting of the American Society for Municipal Improvements.

EXPERIENCE WITH SURFACE-TREATED GRAVEL, LIGHT-TRAFFIC STREETS IN RICHMOND, IND.

By D. B. Davis, City Civil Engineer, Richmond, Ind.

For towns and cities up to 35,000 population a well constructed gravel roadway surface treated with Tarvia B is a most economical pavement to construct and maintain for residence streets which bear a daily traffic up to 1,000 light weight vehicles.

Gravel, being perhaps the most plentiful and commonest of all materials for street building, has not as some suppose, had its day of usefulness. The recent tremendous increase in the price of other street building materials, due to the increases in freight rates and the labor incident to their preparation for the market, has more than anything else caused road engineers to reconsider the real value of gravel.

With its use for residence street construction proper methods of construction should be followed to get satisfactory results. It is not necessary in most cases that elaborate precautions be taken for crushing and screening the gravel unless the proportion of sizes varies considerable from accepted practice. Crushing and screening to sizes adds much to its cost, thereby eliminating the principal advantages of its use. If maximum sizes predominate, it can be run through the crusher before using, although it is doubtful whether the screening to sizes for the different courses in the pavement warrants the expense if crushed stone is at all available. Acceptable pavements have been constructed from crushed bank-run or ordinary bank-run gravel from the pit with percentages of binder up to 15 per cent.

Tarvia B Surface Treatment in Richmond

Some gravel roadways were constructed in Richmond, Ind., during 1918, which were surface treated with Tarvia B in 1919, which are giving excellent service at the present time. The ordinary methods of construction were used. The old worn gravel surface was first scarified with a 10-ton Huber roller with steam scarifier attached, to a depth of 3 ins. New bank-run gravel was spread thereon to a thickness of about 5 ins. A finished crown of about ½ in. to the foot was attained. After thorough harrowing, the gravel was dampened down and rolled. After once setting it with the roller it was more thoroughly wet and re-rolled to a finish. On the final rolling, the surface was brushed by means of a steel brush attached to the roller. This brushing was instrumental in filling the voids of the larger aggregate and to give the surace a smooth pebble-dash finish.

The Gravel Used

The gravel used in Richmond was from the city's pit and approximated the following screen test:

Passing a 1½-in. screen	100.0%
Passing a 1½-in. and retained on ¾-in. screen	11.7%
Passing a ¾-in. and retained on ½-in. screen	6.7%
Passing a ½-in. and retained on ¼-in. screen	16.9%
Passing a ¼-in. and retained on ⅛-in. screen	17.3%
Passing a ⅛-in. and retained on No. 50 screen	29.4%
Passing a No. 50 screen	4.7%
Clay content	13.3%

The clay appears in the gravel as a coating on the pebbles and not as lumps in the mixture.

Before surface treatments are applied, more satisfactory results have been attained by having the street go through the winter season as traffic therefore has an opportunity to help consolidate it.

Preparation of Gravel Surface

The prepartion of the gravel surface for the application of Tarvia B was as follows: First, all depressions of consequence in that part of the surface which had become compact and hard, were repaired and the former contour of the street restored with a mixture of ¾-in. limestone chips and Tarvia X or K-P, then if the gravel surface had had considerable traffic to compact it, it was swept with a rotary broom to a hard surface and all loose materials removed to the gutter with shovels, where it was later removed by wagons after the application of Tarvia B.

In case the roadway is not thoroughly compact, even through the center, all foreign matter is removed by shovels, but the sweeping is omitted. Sweeping in such a case would loosen the surface particles. Although it does not mean that poor results will be obtained when the surface particles are loose, it does require additional work and care to get the same results as if the gravel was originally hard and smooth.

When the surface has been prepared, the Tarvia B is applied cold by means of a pressure distributor, care being taken that every part of the surface is uniformly covered. For the first treatment from 1/3 to ½ gal. to the square yard is required; subsequent treatments will vary from ¼ to 1/5 gal. per square yard. On the first application no covering is necessary, although for subsequent applications clean chips or pea gravel will add to the endurance of the surface.

Streets which cannot receive a treatment following the initial one should not be treated at all; as it has been demonstrated here that it requires this second treatment to perfect the surface. A street with loose surface requires a second application within one month after the first. Failure is sure to result if this is not done. Take where the surface material is not compact and cannot be swept; shortly after the Tarvia is applied, traffic will disturb the surface to the extent that at certain places in the roadway the untreated gravel will become exposed and it may become dusty. After the initial treatment, it is very important to endeavor to distribute the traffic to all points over the street, to iron out the surface. This has been expedited here by the placing of signs along the street with the words: "Help make a good street. Drive on the side." Whenever the traffic has become general over the entire area, say within a month or so, a second application of ¼ gal. per sq. yd. of Tarvia B is applied.

Tarvia B treated gravel streets in Richmond, Indiana, have required a minimum of maintenance for the above stated traffic census, although we find that it is essential

faithfully to watch them at first and repair at once any breaks which may occur. For this purpose, a maintenance patrol gang, consisting of a one-horse wagon with driver and two helpers, is used. In the wagon is carried ¾-in. stone chips and coarse sand in separate compartments; behind, is drawn a tar heating kettle of Tarvia X. The shallow holes or ruts are repaired by pouring a little hot Tarvia over the surface and spreading a heavy coating of coarse sand over the Tarvia while it is still hot. The deeper holes are filled to within ¼ in. of the surface with ¾-in. chips, smoothed off and tamped, then the hot Tarvia X poured over and around them. One and one-half gallons of Tarvia X is used per square yard of

VIEW OF GRAVEL ROADWAY ON N. 21ST STREET, RICHMOND, IND., AFTER TWO SURFACE TREATMENTS WITH TARVIA B.

patch. Coarse sand is spread over the patch to give it a final finish and make it possible to allow traffic to go upon it immediately.

Should a street a year or so after being treated become subjected to extraordinary traffic or become badly rutted during the winter or spring season, it is scarified, harrowed, reshaped and re-rolled as in the original construction. The old Tarvia B retains its life and mixes with the gravel to the extent that a crust from 1 to 1½ ins. is formed. Soon after, the street is given ¼ gal. per sq. yd. of Tarvia B and covered lightly with pea gravel.

Cost of Patching by Patrol Gang Using Tarvia X

Patches of average depth of 1½ ins. and average area of 4½ sq. ft. The gang makes an average of 88 patches in one-half day.

Labor			
5 hours one-horse wagon at 75c per hour	$3.75		
10 hours 2 helpers at.....60c per hour	6.00		
		$9.75	$.025 sq.ft.
Material			
32 cu. ft. stone chips at $2.50 per cu. yd.	$2.96		
16 cu. ft. sand at..... 2.00 per cu. yd.	1.20		
70 gal. Tarvia X at... 23c per gal.	16.10		
		$20.26	$.050 sq.ft.
Cost per sq. ft. was $.075		$30.01	

Resurfacing of streets with gravel is done by the street department forces under the direction of the City Engineer and is paid for from the City's General Fund. No expense is incurred by the property owners whatever. The cost for re-surfacing with gravel approximates the following:

Cost of Gravel.		
Cost of bank-run gravel at the pit.....	$0.50	per cu. yd.
Hauling by teams, 6 loads per day		
1½ yds. per load, team 75c per hour..	0.84	" " "
Spreading on street at 50c per hour.....	0.16	" " "
Extra man at pit loading at 50c per hr....	0.16	" " "
Cost of gravel on street per cu. yd.....	$1.66	" " "
Cost of Re-surfacing.		
Gravel delivered and spread at $1.66.....	$0.37	per sq. yd.
5 ins. finished depth req. 0.22 cu. yds.		
Scarifying and rolling with roller.....	0.08	" " "
Cost per square yard	$0.45	" " "

The Tarvia B is applied by the city forces on petition from the people who reside on the street. Tables of estimates are prepared and kept on file by the Engineer for tarviating each block in the city. These tables of estimates show the width and length of each individual city block, together with the rate of cost per lineal foot and the total cost to the property owners for each block. This amount must be deposited with the city before any work is started.

Engineer's Estimate for Tarvia B Treatment—One Application of ¼ gal. Per Sq. Yd.

0.003 cu. yds. pea gravel covering at $1.75 per cu. yd...	$.005
Tarvia B F.O.B. track at 12c per gal.....	.030
Estimate per square yard	$.050

As an encouragement to the people, the city has agreed to pay one-third of the cost to the property and all the cost of the intersections.

During the years 1919 and 1920 this city has surface treated 245,000 sq. yds. of street surfaces.

The foregoing paper by Mr. Davis was presented by Mr. Davis at the 1920 annual convention of the American Society for Municipal Improvements.

ASPHALTIC PAVEMENT CONSTRUCTION ON AN ILLINOIS HIGHWAY AND THE CHICAGO BOULEVARD LINK

By John B. Hittell, District Engineer, The Asphalt Association, 29 S. LaSalle St., Chicago, Ill.

For purposes of comparison and perhaps future study it was thought of possible interest to the members of the American Society for Municipal Improvements to present a brief description of two asphaltic types of construction recently designed and constructed, or under construction, and each of which will have a large amount of traffic, said Mr. Hittel in addressing the recent annual convention of the Society at St. Louis.

While there is nothing exceptionally distinct in the designs from the usual yet there is this: in one case a rather unusually rich mix was used in the cement foundation, and in the other an attempt was made to secure a "stiff" top mixture.

The highway or road type was selected because it is the only one, as far as the writer knows, which was contracted for by the Illinois Highway Department during 1919, the other because it is part of the $15,000,000 Boulevard Link improvement in Chicago and hence very likely to be recognized by many at once. The one is suburban with unrestricted traffic of unknown amount and sparsely policed—the other metropolitan with restricted but intense traffic, which at times is all it can carry. Asphaltic concrete and sheet asphalt with binder courses of

equal thickness are placed against each other and future study may throw some important light on the relative value of these paving surfaces.

Asphaltic Concrete

It is the custom of the State Highway Department of Illinois to call for bids on alternate types of construction, viz.: Portland cement concrete and bituminous concrete pavements; sepcifying that the latter, with a wearing surface 2 or 3 ins. in thickness, shall be laid on the same mix of concrete as the cement pavement, with the exception that the concrete for the foundation shall be 1 in. less in thickness than that specified for the concrete pavement.

Federal Aid Project No. 4

In 1919 bids were called for Sections A, B, C and D of project four, Federal Aid, on what is known as the Chicago, Waukegan and Milwaukee Road lying in Cook and Lake Counties—roughly 3 miles in the former and 17 miles in the latter. The R. F. Conway Co. of Chicago. a firm of ample capital and large experience in the construction of all classes of street pavements, and successful in completing several concrete road contracts with the Department, was awarded the contracts on Sections A and B for asphaltic concrete and C and D for cement concrete. The asphalt bids were about $7,200 per mile greater than those for cement concrete. Undoubtedly the authorities in charge desired to avail themselves of an opportunity to make a fair comparison between bituminous and cement concrete highway construction, as the conditions were ideal—the same soil, traffic, widths of roadway, a thoroughly equipped and experienced contractor, and the fact that the asphalt would connect at each end with a cement road.

METHOD OF ROUGHENING CONCRETE FOR ASPHALT TOPPING ON CHICAGO, WAUKEGAN AND MILWAUKEE ROAD, FEDERAL AID PROJECT NO. 4, ILLINOIS HIGHWAYS.

As its name implies the project, when completed, will furnish a road connecting the manufacturing cities of Chicago, Waukegan and Milwaukee, and very likely is destined to a heavy traffic.

Section A at the south end of the job, comprises 48,507 sq. yds. of pavement, and Section B, which is contiguous, comprises 36,929 sq. yds., and jointly extend a distance of almost eight miles. To avoid repetition hereafter Sections A and B will be spoken of as the road and is the only part in consideration in this article.

The road commences at the village of Techny and runs northwesterly through the villages of Shermerville, Deerfield and Everett. At Techny it connects with a cement concrete road which is 18 ft. in width, 7 ins. in thickness at the sides and 8 ins. in the center; mix 1:2:3½.

The road extends through typical Illinois farming country and in part was an old macadam highway, with the exception of a stretch of about three miles running from Deerfield to Everett, which is new location through farm lands. The old macadam was of varying width and in all instances less than that of the finished road, and on account of the cut is practically of no material value as a support for the pavement. The soil throughout is of clay and drainage is similar to that of other roads built in the State consisting of side ditches, cross culverts, etc.

Grading

During the process of grading long stretches of light cutting were encountered and to facilitate this a large Koehring grader was employed with the result that the operations at times reached the point where 3 yd. wagons were loaded at the rate of 75 per hour. At the end of one of the cuts where a 3-ft. fill was made the soil was such that horses mired themselves and were unable to move their loads. This was overcome successfully by employing a large caterpillar tractor to which was attached three wagons.

Central Mixing

In the first part of 1920 a central mixing plant, consisting of two four-bag mixers, was installed for mixing concrete, which was then hauled in trucks for a distance of 2½ miles and deposited on the grade. This system proved successful during the early stages of the work but had to be abandoned later owing to the inability of the material producers to supply the quantity of materials necessary to operate the mixers simultaneously.

Use of Light Trucks

At the present writing (August, 1920) concrete is being laid south from the village of Everett. The materials for the concrete are hauled in bodies mounted on a Ford chassis, a body being sufficiently large to contain one batch of four bags of cement, sand, and stone in the proportions of 1:2:3½. The truck is first loaded with four bags of cement from the pile or car, then to the sand car where the sand has been previously shoveled into a box attached to the side of the car from which it is emptied into the truck. This box is readily moved from one point to another on the side of the car, and is sized to hold twice the portion of cement. The necessary amount of coarse aggregate is added and is gaged by the size of the body. About 25 of these trucks are employed, and being equipped with 4½-in. tires on the rear wheels, very materially help to compact the subgrade. In fact the District Engineer of the State Highway Department advised me that there is practically no rolling of the fine grade. The line and grade is maintained by steel forms and exact subgrade secured by a strike board drawn along the same. The condition of the subgrade is excellent.

The concrete is 6 ins. at the sides and 7 ins. at the center and the difference makes the crown for the finished pavement. On tangent lines the subgrade is flat. The State 1920 specifications call for cement concrete

pavements to be uniformly 8 ins. in thickness with a crowned subgrade, and 7-in. foundation for bituminous pavements.

Superelevation

On curves the superelevation is as follows—the width being 18 ft.:

6° 30′	15″
6	13¾
5 30	12⅜
5	11¼
4 30	10⅛
4	8¾
3 30	7⅜
3	5⅞
2 30	4⅜
2	2½

The rise on curves of 7 degrees (about 800 ft. radius) or less, is 1 in. per foot of width.

The maximum gradient is not over three per cent., except at bridge approaches where it is 4½ per cent.

The concrete at the time observed was not as stiff as might be expected but the inspector explained this was due to the excessively hot day and the fact that the gravel was running a trifle small. With a change of gravel this condition was remedied. A Lakewood mechanical tamper has been used but at the time stated compression was obtained by a large wooden tamper operated by two men, one at each side of the roadway.

Curbing

In the specifications originally no curb was provided for the bituminous surface, but wisely through an agreement between the contractor and officials a curb 4 ins. in width and about 3 ins. in height is being built integrally with the foundation. The height is a trifle less than 3 ins. in order that the wearing course may be thoroughly compacted at the edge of the curb. The average progress of the concrete foundation with curbing is over 400 ft. per day.

Rough Rolling

Last fall when the work was first started brooms were used to roughen the surface of the concrete, but this method was very shortly superseded by the hand roller shown in the accompanying view. This roller was designed by Mr. G. N. Lamb, District Engineer of the State Highway Department, and consists essentially of 5 ft. of 10-in. wrought iron pipe sealed at both ends, to which has been attached at intervals of 5 ins. ordinary 1-in. angle irons. The roller is operated by two men, one on each side of the roadway and corrugations are made roughly at an angle of about 60 degrees both to the right and left of the center line of the road leaving the surface roughly "diamond" shaped. The result is very satisfactory. Curing of the concrete is secured by the use of wet tarpaulins and flooding afterwards. No earth is used for this purpose as it is not considered possible to remove it afterwards from the rough concrete in a satisfactory manner.

Four thousand feet of finished roadway was laid in 1919. The concrete was started on Sept. 24th, while the binder and top was laid during the week of Nov. 20th. Owing to the lateness of the season the contractor ran these materials from his Elston Ave. plant in Chicago, hauling it in 7½-ton trucks a distance of 17 miles. The penetration varied between 56 and 68. Inspection was had by the State at the plant, on the work and by its laboratory at Springfield.

To finish this year more than seven miles of binder and top the contractor has installed at Deerfield a one car Cummer plant of capacity of approximately 200 tons or 700 lin. ft. of completed bituminous work. The hauling will average two miles. Two tanks of about 18,000 gal. capacity, one for fuel oil and one for asphalt cement, will be used to guard against intermittent supply of these materials.

Asphalt Requirements

The specifications gave the bidder the latitude of selecting an asphalt of any of the well known brands as well as tar for the bituminous cement, and the option of bidding with or without a binder course. He chose the binder course and bid on an asphalt meeting the following requirements:

Specific gravity 25°C./25°C. (77°F. 1.020 to 1.060).
Flash point not less than 177°C. (350°F.)
Ductility at 25°C. (77°F.) not less than 100 cm.
Penetration at 25°C. (77°F.), 100 gm., 5 sec., 55 to 75.
Loss at 163°C. (325°F.), 5 hours, not over 2.0%.
Penetration of residue at 25°C. (77°F.), 100 gm., 5 sec., not less than 30.
Total bitumen, not less than 99.5%.
Per cent of total bitumen insoluble in 86°B. naphtha 15.0 to 29.0
Fixed carbon, 9.0% to 17.0%.

The mixer for the binder course shall be composed of asphaltic cement or tar, stone chips and fine aggregate. The materials shall be so combined that the mixture shall contain average proportions by weight as follows:

Bitumen	4½% to 6½%
Mineral passing 10 mesh	15 % to 30 %
Mineral passing 2 mesh and retained on 10 mesh	40 % to 70 %
Mineral passing 1 mesh and retained on 2 mesh	10 % to 30 %

The mixture for the wearing course shall be composed of coarse aggregate, fine aggregate, filler and asphaltic cement or tar. The materials shall be so combined that the mixture shall contain average proportions by weight as follows:

Bitumen	7½% to 9%
Mineral passing 200 mesh	7% to 10%
Mineral passing 40 mesh and retained on 200 mesh	20% to 30%
Mineral passing 10 mesh and retained on 40 mesh	25% to 35%
Mineral passing 4 mesh and retained on 10 mesh	8% to 22%
Mineral passing 2 mesh and retained on 4 mesh	0% to 10%
Mineral passing 2 mesh and retained on 10 mesh	18% to 32%

No guarantee is required.

The construction of this asphaltic road and the connecting cement road by the same contractor, and under conditions as equal as can be had, will give an exceptional and excellent opportunity for the observation of the effect which different factors have upon the life and service of a pavement. Many engineers believe that this foundation is needlessly expensive.

Traffic Notes

The beginning of the road is 19 miles from the City Hall in Chicago. On Sunday, Aug. 8th, and Monday following, Mr. Geo. A. Quinlan, County Superintendent of Highways, took a count of the traffic on Milwaukee Ave. between Dempster St. and Ballard Road, a point located 15 miles from the Hall. The results are as follows:

SUNDAY

TIME	Pleasure Cars	Motor Trucks	Total	Weather
12 P. M. to 1 A. M.	130	7	137	Fair
1 A. M. to 2 A. M.	43	2	45	Fair
2 A. M. to 3 A. M.	160	2	162	Cloudy
3 A. M. to 4 A. M.	142	2	144	Cloudy
4 A. M. to 5 A. M.	66	—	66	Rain
5 A. M. to 6 A. M.	78	—	78	Rain
6 A. M. to 7 A. M.	40	—	40	Clear
7 A. M. to 8 A. M.	280	20	300	Clear
8 A. M. to 9 A. M.	200	11	211	Clear
9 A. M. to 10 A. M.	391	28	419	Clear
10 A. M. to 11 A. M.	567	63	630	Fair
11 A. M. to 12 N.	500	45	545	Fair
12 N. to 1 P. M.	500	51	551	Fair

1 P. M. to 2 P. M.	394	19	413	Fair
2 P. M. to 3 P. M.	513	17	530	Fair
3 P. M. to 4 P. M.	757	16	773	Fair
4 P. M. to 5 P. M.	1000	15	1015	Fair
5 P. M. to 6 P. M.	1027	29	1056	Fair
6 P. M. to 7 P. M.	1126	45	1171	Fair
7 P. M. to 8 P. M.	1207	70	1277	Fair
8 P. M. to 9 P. M.	1148	61	1209	Fair
9 P. M. to 10 P. M.	709	23	732	Clear
10 P. M. to 11 P. M.	294	11	305	Clear
11 P. M. to 12 M.	179	3	182	Clear
Grand Total....			11,991	
MONDAY				
12 M. to 1 A. M.	86	2	88	Fair
1 A. M. to 2 A. M.	28	1	29	Fair
2 A. M. to 3 A. M.	18	—	18	Fair
3 A. M. to 4 A. M.	23	2	25	Cloudy
4 A. M. to 5 A. M.	34	—	34	Cloudy
5 A. M. to 6 A. M.	48	5	53	Cloudy
6 A. M. to 7 A. M.	53	7	60	Cloudy
7 A. M. to 8 A. M.	135	21	156	Cloudy
8 A. M. to 9 A. M.	95	5	100	Fair
9 A. M. to 10 A. M.	121	21	142	Fair
10 A. M. to 11 A. M.	137	20	157	Fair
11 A. M. to 12 N.	102	20	122	Cloudy
12 N. to 1 P. M.	93	18	111	Cloudy
1 P. M. to 2 P. M.	90	13	103	Cloudy
2 P. M. to 3 P. M.	110	17	127	Cloudy
3 P. M. to 4 P. M.	110	13	123	Cloudy
4 P. M. to 5 P. M.	152	19	171	Pt. Cldy
5 P. M. to 6 P. M.	168	27	195	Cloudy
6 P. M. to 7 P. M.	102	19	121	Cloudy
7 P. M. to 8 P. M.	203	20	223	Cloudy
8 P. M. to 9 P. M.	288	15	303	Cloudy
9 P. M. to 10 P. M.	112	7	119	Clear
10 P. M. to 11 P. M.	86	6	92	Clear
11 P. M. to 12 M.	48	1	49	Clear
Grand Total....			2,721	

The percentage of motor trucks of all vehicles was 5 minus on Sunday and 10 plus on Monday. Neither of these days of the week was probably as good as any of the remaining five days to ascertain the amount of truckage since business is generally suspended on Sunday. Deliveries are usually from the city on Monday's orders, and farm produce is seldom loaded on Sunday for Monday delivery. Trucks to all motor vehicles is 12.6 per cent. in the State and 20.1 per cent. in Chicago.

Speed and Weight Regulations

The Illinois Motor Vehicle Law provides that the weights shall be limited as follows:

> The maximum gross load to be permitted on any axle of any vehicle shall not exceed 16,000 lbs.; and the gross weight of any vehicle, including the weight of the vehicle and maximum load, shall not exceed 800 lbs. per inch of the average width of tire of the road wheels of such vehicles in actual contact with the surface of the road.
>
> Weight limits 50 per cent. above those provided for herein may be permitted by ordinance in cities having a population of more than 20,000, but such increase shall not apply to vehicles when outside the limits of such a city.

SPEED LIMITS

Weight of Vehicles and Load	Pneumatic Tires	Two or More Solid Tires
5,000 lbs.	25 mi. per hr.	20 mi. per hr.
5,000 lbs.—not more than 12,000 lbs.	20 mi. per hr.	15 mi. per hr.
12,000 lbs.—not more than 15,000 lbs.	15 mi. per hr.	12 mi. per hr.
More than 15,000 lbs.	12 mi. per hr.	12 mi. per hr.

Permits may be issued for specially heavy loads or vehicles. When frost is leaving the ground, officials may on a definitely designated highway, prohibit the operations of vehicles having a gross weight, including weight of vehicle and load, of more than 5,000 lbs., by posting notices along such road. The entire time of such embargo shall not exceed 45 days in any one year.

Highway Patrol Work

The County Superintendent of Highways has a force of about 12 men who are assigned to patrol about 200 miles of the most important highways in Cook County.

The offenses which occur most frequently are such as a driver keeping his vehicle in the center of the road, vehicles parking on paved highways to make repairs or to purchase vegetables, vehicles turning from the main highway and stopping on a comparatively untraveled cross road with turned off lights, and the usual offenses against speeding and reckless driving. In the springtime when the frost is coming out particular attention is given to over-loading of trucks, and this menace was very well corrected after a thorough conference among parties interested. This offense is committed chiefly by trucks hauling building material. This hauling is generally done by individuals or firms owning trucks for the large producers of building supplies. The owner is not the responsible party as the driver benefits in pay by handling exceptionally heavy loads. The need of enforcing the law on this point is necessary on account of the condition of the culverts and bridges which have been built for quite a number of years.

Sheet Asphalt on Boulevard Link

The sheet asphalt pavement on the north and south approaches to the new Boulevard Link Bridge, and laid in connection with the widening and extension of Michigan Ave. and Pine St., from Randolph St. to Chicago Ave. will be observed by all that have an opportunity and are interested in pavements.

This improvement consisting of condemnation of lands and buildings on a frontage of ¾ mile, adjusting underground facilities, constructing sewers, sidewalks, electrical lines, depressing intersecting streets, building lower and upper level roadways for commercial and pleasure traffic, erecting a double Bascule bridge with two leaves, each 170 ft. long, is a magnificent work of credit to all concerned.

The roadways on Michigan Ave. and Pine St. formerly were 38 ft. in width, and all continuous traffic passing over them crossed Rush St. bridge, which had two roadways, each 17½ ft. wide. The roadway of the new bridge is 54 ft. wide—the south approach and the north approach roadways are respectively 75 and 80 ft. in width.

As soon as rights to the property were obtained and the obstructions removed, work preliminary to paving was commenced. The stretch of paving from Chicago Ave. to Ohio St., covering 17,850 sq. yds., was paved between July 25th and Oct. 15th, 1918. The remaining asphalt pavement on the north and south approaches—progress of which was dependent on the iron work—was finished early this year.

The rehabilitation of underground service and installation of new ones, the old basements and sidewalk subareas, required special care in preparing a foundation for the pavement, and the specification wisely provided for sand filling where directed by the Board of Local Improvements.

The paving specifications were: Concrete base 8 ins. in thickness, mixed in proportion of 1:3:6. Binder course 1½ ins. in thickness, composed of stone varying in size from 1 in. downwards, sand and bitumen, resulting in mixture containing 4 to 7 per cent. of bitumen, and from 20 to 30 per cent. of material passing a 10 mesh screen.

The surface mixture and a test of one batch as follows:

	Specifications	Test	Composition
Bitumen	10-12	10.5	Trinidad 76%
sieve	15-20	18.0	
Sand passing 80 mesh sieve	20-30	21.6	
Portland cement and mineral matter passing 200 mesh			I. R. C. 24%
Sand passing 40	20-40	38.2	Penetration 40
Sand passing 10	8-20	10.5	
Sand passing 4	5-10	1.2	

The gradient on the approaches is under 2 per cent. and most of the work is on a level grade. On level stretches the crown on the 80-ft. roadway is 10 ins. with a parabolic curve; on gradients this was reduced to 9 ins. The reasons for these flat surfaces probably were to accommodate traffic comfortably near the curb lines, coupled with the assurance that these roadways being boulevards would be kept clean.

Guarantee

It is understood and agreed that all labor and material shall be of such character that the entire work shall be and remain in good condition during the entire period of one year, except that for all pavements the period shall be two years, from the acceptance of the work, and the contractor hereby agrees to keep in perfect repair, during such period, the whole of his work, except in cases where the repairs may be rendered necessary by causes clearly beyond his control. The keeping and maintaining of said improvement in continuous good order and condition for the above mentioned period shall include all repairs to be made, or if necessary the entire reconstruction of the work as said Board of Local Improvements may direct, without any additional charge or cost to the City of Chicago, except as hereinafter provided.

As a basis for the interpretation of the satisfactory condition of the pavement during the period of the guaranty and at the expiration thereof, it is hereby agreed and understood that if the foundation and binder are sound, and the entire wearing surface of the roadway shall possess a minimum thickness of 75 per cent. of the original specified wearing surface and be in a smooth condition for travel and shall be free from cracks which show indications of disintegration of the wearing surface, it shall be considered as meeting the requirements of said guaranty.

To enforce this guarantee 5 per cent. of the cost of the pavement is retained and upon which interest is paid. One-half is returnable at the expiration of one year.

The improvement was made solely to accommodate pleasure car traffic between the two sides of the river and to provide separate roadways for commercial traffic to and from the railroad freight yards.

Traffic Notes

The number of cars is very large and during the rush hours of the morning and evening the entire roadway is covered. Speeds of 25 and 30 miles per hour are common at these times and are not opposed by the officers policing the road.

The Chicago Motor Bus Co. operates a line of busses of two types weighing empty 10,500 and 11,500 lbs., having an allowable ordinance capacity of 50 and 60 persons respectively. Application to use a type carrying 60 passengers and weighing 12,500 lbs. has been made to the authorities and one of this class is now operating under temporary permit.

By ordinance the schedule interval, except at midnight, is not more than 20 minutes "or satisfactory service." In fact the rush at morning and evening intervals is about 2 minutes and during the rest of the day 10 minutes. The rate of speed ranges from 15 to 20 miles per hour. Genuine co-operation has prevailed among the company's officials and the authorities, with the result that the destructive effect of this traffic on the pavement has been reduced.

AUTOMOBILE COUNT AT PEARSON ST. (200 FT. NORTH OF CHICAGO AVE.) AND NORTH MICHIGAN AVE. SUNDAY, FEB. 29, 1920

10 A. M. to 7 P. M. Tem. 60°

10 to 11	400
11 to 12	550
12 to 1	750
1 to 2	900
2 to 3	1,150
3 to 4	1,550
4 to 5	1,700
5 to 6	1,300
6 to 7	1,100
	9,400

AUTOMOBILE COUNT AT LAKE SHORE DRIVE (N. MICHIGAN AVE.) AND OAK ST. (1,300 FT. NORTH OF CHICAGO AVE.) SUNDAY, JULY 25, 1920

12 Noon to 7 P. M. Tem. 60°

12 to 1	900
1 to 2	1,300
2 to 3	1,700
3 to 4	2,300
4 to 5	2,500
5 to 6	2,100
6 to 7	1,900
	12,700

The B. F. Goodrich Rubber Co. on Wednesday, August 11, 1920, took a count of the traffic at Michigan Ave. and Jackson Blvd., a point about six blocks south of Randolph St., as follows:

Time	No. Bound	So. Bound	Total
7 to 8 A. M.	574	786	1,360
8 to 9 A. M.	1,444	1,702	3,146
9 to 10 A. M.	1,635	1,668	3,303
10 to 11 A. M.	1,655	1,422	3,077
11 to 12 M.	1,526	1,461	2,987
12 to 1 P. M.	1,329	1,407	2,736
1 to 2 P. M.	1,523	1,521	3,044
2 to 3 P. M.	1,556	1,744	3,300
3 to 4 P. M.	1,740	1,717	3,457
4 to 5 P. M.	1,783	1,845	3,628
5 to 6 P. M.	1,942	1,978	3,920
6 to 7 P. M.	1,405	1,302	2,707
	18,112	18,553	36,665
Average per hour	1,509	1,546	3,055
Average per minute	25	25	50

The traffic of the rubber tired motor truck, heavily loaded and moving rapidly, together with the nearly total abolition of steel tired vehicles, has changed the wear on roadway surfaces mostly from attrition to distortion under impact. The impact tests now being conducted by the Bureau of Public Roads to determine the amount of impact delivered to road surfaces, and the effect of this impact on different types of surfaces are timely and of great value. With customary speeds and loads these impacts have been shown to be very heavy and pavement surfaces in the future must be made as near uniform as possible and be composed of tough materials. With the cushioning effect of rubber acknowledged, the tests showing the cushioning effect of bituminous paving surfaces will be awaited with great interest.

The curve of number of motor vehicles in the United States, including the District of Columbia from 1913 to 1919 was practically a straight line. A change from present economic conditions which is thought imminent may change the trend of the curve due to a lesser increase in the number of passenger vehicles. Trucks will increase and the truck owner is vitally interested in the construction and preparation of good roads. If he persists, however, in carrying excessive loads at high speed there can be but one result—drastic laws rigidly enforced. The

two instances referred to in this article show that co-operation is better at times than legislation. If or not prescribed to weight and speed, the truck owner is conscious that he is contributing financially in a large way to road construction, and will voice a demand for a type that will make operation and maintenance of trucks the most favorable to him.

Surfaces in use today may be characterized as rigid, and flexible or resilient. A smooth, flexible, resilient surface reduces the amount of tire wear and the stresses due to motion in the mechanism and structure of the vehicle. When "favorableness to motor vehicles" becomes a factor, as it shortly will, in determining the selection of a type of construction, the bituminous pavements combining smoothness, flexibility, and resiliency have decided advantages on this score over other types.

For data and information the writer is indebted to Mr. G. N. Lamb, District Engineer of the State Highway Department of Illinois, Mr. Geo. A. Quinlan, Superintendent of Highways, Cook County, Ill., and representatives of the R. F. Conway Co., and which is here gratefully acknowledged.

SURFACE TREATING STREETS WITH LIQUID ASPHALT IN WALPOLE, MASS.

By E. F. Durfee, Superintendent of Streets and Town Engineer, Walpole, Mass.

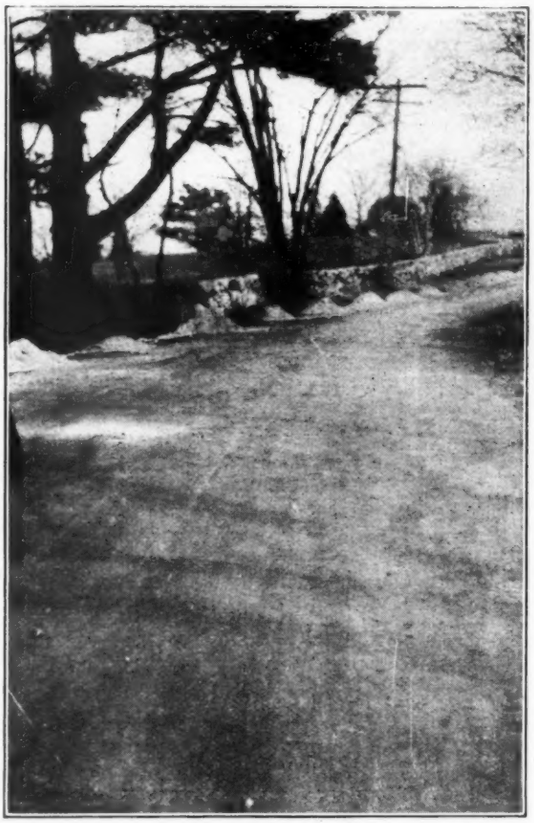
One of the paramount problems with which a highway engineer is confronted is the selection of the proper material for certain work. In this connection there is a possibility of two mistakes. An inexperienced engineer may choose a material which does not come up to the requirements; or he may select a material which would exceed the needs of the particular street. In the first case true economy is not practiced because the road will soon need a second treatment. In the second case the

MEDFIELD STREET, WALPOLE, MASS., GRAVEL TREATED WITH TEXACO NO. 55 ROAD OIL.

difference between the cost of the proper material and the selected type is a pure loss.

Walpole, Mass., was confronted with just such a problem. Several of the streets in the town were in a deplorable condition. Incessant traffic had developed pot holes and ruts which were difficult to repair. The town originally had planned to construct some type of permanent construction, but owing to lack of funds the thought was abandoned. It finally was decided to employ liquid asphalt in surface treating the roads.

The first step in the work was to fill all depressions in the road with gravel. When traffic had been permitted on the road for a time, the gravel was treated with Texaco Liquid Asphalt. Sand was spread over the patches to absorb all surplus asphalt. For a week the



ROAD IN WALPOLE, MASS., TREATED WITH GRAVEL AND TEXACO NO. 55 ROAD OIL IN 1919.

street was opened to traffic, which served to level off and thoroughly consolidate the patching. Then the entire road was gone over with a road drag to bring it to uniform grade and contour. This completed, it was ready for the application of the main treatment of asphalt.

Texaco Liquid Asphalt No. 1 was distributed by truck at the rate of 1/3 to ¼ gal. per sq. yd. The work of spreading the oil was facilitated by heating the material to a temperature of 150 degrees Fahrenheit. The liquid asphalt was covered immediately with fine gravel at the rate of 20 lbs. per sq. yd.

Finally the road was raked to remove all large stone and a roller was run over the street to crush the remaining stone. The liquid asphalt and gravel mixture formed a mat ¼-in. thick, which greatly reduced the disintegrating effect of traffic.

Every two weeks the street receives a thorough inspection, all weak spots being reinforced; in this way the life of the pavement is increased. The roads in Walpole treated in this manner are standing up under traffic as well as a more permanent type of construction.

The cost of the work might prove useful to engineers who contemplate using liquid asphalt in surface treating their highways. The oil applied cost 14¾ cts. per gallon.

Everett Avenue, Winchester, Mass., built with "Tarvia-X" in 1915. The avenue is a clean, durable, easy-traction roadway maintained at a minimum expense.

Tarvia
Preserves Roads Prevents Dust

Sheffield Road, Winchester, Mass., a macadam road kept in perfect condition by an occasional treatment with "Tarvia-B".

Tarvia Roads cost *less* than untreated roads—

"OUR uniformly clean streets are the pride of the town and *Tarvia is responsible for this condition.*"

So writes Mr. T. Parker Clarke, Superintendent of Highways, Winchester (Mass.), who has been using Tarvia extensively ever since 1908, both for gravel and waterbound macadam roads and streets.

The saving in maintenance has been so considerable since the use of Tarvia that instead of spending all his appropriation on the streets in the central part of the town, he is able to take care also of *many outlying districts which formerly were entirely neglected.*

This is another striking proof of the fact that it is actually cheaper to treat your roads and streets with Tarvia than to leave them untreated.

The small extra first cost is quickly balanced by the saving in repair bills and this saving gets bigger every year because Tarvia roads do not wear out as do untreated roads, but only require an occasional surface treatment to keep them in excellent condition.

Tarvia is a coal-tar preparation, low in cost and easily applied, which renders your roads dustless, mudless, frost-proof and automobile proof. Tarviated roads are the one economical solution of the problem of high-grade low-cost roads for cities, towns and country districts.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will be given prompt attention.

Illustrated booklet telling about the various Tarvia treatments, free on request.

New York Chicago Philadelphia Boston
Detroit New Orleans Birmingham Kansas City
Salt Lake City Seattle Peoria Atlanta Duluth
Lebanon Youngstown Toledo Columbus
Buffalo Baltimore Omaha

The Barrett Company

St. Louis Cleveland Cincinnati Pittsburgh
Minneapolis Dallas Nashville Syracuse
Milwaukee Bangor Washington Johnstown
Richmond Latrobe Bethlehem Elizabeth
Houston Denver Jacksonville

THE BARRETT COMPANY, Limited: Montreal Toronto Winnipeg Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

The sand placed in piles every 20 ft. along the road cost about $1 for 2,750 lbs.

Sixteen men and a foreman and a 3-ton truck were required to cover the oil with sand. The truck was used to cover any place where the sand ran short or where pools of oil showed after the sanding gang had passed on. This size gang was able to cover about 4,000 gal. of oil per day of eight hours.

The steam roller would have been standing idle at this time, so no charges were made for its use.

Three one-horse carts and four men were used to rake off the stone. The gravel ran about 15 per cent. stone over ¾-in.

THE RELATION OF HOUSING TO ENGINEERING

(Editor's Note: The following discussion of The Relation of Housing to Engineering is the text of the report of the Housing Committee of the Sanitary Engineering Section of the American Public Health Association as presented at the 1920 annual convention of the Association. Mr. Morris Knowles, of Pittsburgh, was chairman of the Committee and the other members were: John W. Alvord, of Chicago, W. C. Folsom, of Cincinnati, George A. Shaw, of Philadelphia and Mr. Groeniger, of Columbus, Ohio).

Of all the reconstruction problems which have followed in the wake of the war, none has attracted more general interest or has pressed upon a larger proportion of the people than the housing problem. The shortage of homes is world-wide. Cessation of house building during the war, together with the growth of population, especially in industrial centers, have resulted in a deficiency below actual needs, which has been estimated, for the United States, at about two million homes. At the same time, the great increase in construction costs, the difficulty of financing new construction, the lack of incentive to private builders arising out of the lag in rents behind construction costs and the general uncertainty of the situation, have broken down the economic machinery by which the need for homes is ordinarily supplied. Extraordinary measures have therefore appeared to be required, and government housing and loans to home builders have become established policies in Great Britain, Canada and elsewhere. In our own country, we have seen millions expended in government housing during the war by the United States Shipping Board and the United States Housing Corporation; and within the past year "home loan bank" legislation has been considered, both in Congress and in the legislatures of several of the states.

Under these conditions, it is most appropriate that the Sanitary Engineering Section of the American Public Health Association should have appointed a Committee on Housing, and that consideration should be given at this time to the relation of housing to engineering.

Development of Problem

The housing problem, growing out of the concentration of population in cities which resulted from the growth of industry under the factory system, first evidenced itself in the development of unsocial and insanitary home conditions. It is natural, therefore, that the first efforts at its solution should have taken the form of exposure of these evil conditions and of criticism of their effects. This led naturally to the second phase of the attack on the problem, namely, the elimination of such conditions by governmental regulation and the adoption of restrictive legislation fixing minimum standards for light, air, sanitation and convenience. In all of these matters, sanitary engineers have performed, and are still performing, notable services.

The housing problem of today, however, is a problem of planning and construction, and in its solution the engineer has a so much wider field of activity and so much greater responsibility and opportunity than at any preceding stage of the development of the problem, that it seems desirable to confine the remainder of this brief report to a consideration of the relation of engineering to the present-day problem of housing construction.

Professional Co-operation

It is of course true that engineering is only one of the professions that must be drawn upon for the solution of the housing problem. Any solution that is of value must result from the co-operation of the landscape architect, the engineer, the architect, the sanitarian, the constructor, the realtor and the public-spirited citizens of the community. The part played by the engineer, however, is not generally enough recognized or understood. This summary statement, therefore, will serve a useful purpose if, while emphasizing the need of co-operation, it can contribute to better appreciation of the extent to which the problem is an engineering one.

Organization and Finance

Under present conditions, one of the most difficult steps in the solution of the housing problem is the organization and financing of housing construction. To this problem the engineer can apply his training in fundamental economics and comparison of values in such a manner as to be of as much service as any other citizen. It is also essential to the success of a construction program that a definite policy of "quantity production" be inaugurated from the beginning and be made the basis of the financial and organization plan. For this consideration, the engineer is, of course, especially well qualified. In these stages of the problem, the engineer is more likely to be interested as a public-spirited citizen rather than as a professional advisor, and yet in view of all the effort now being made to enlarge the civic activities of the profession, it does not seem inappropriate to call attention at this time to this field of opportunity for the engineer in connection with housing.

Selection of Site

Where houses are to be constructed in groups, the proper selection of sites is of vital importance, and the services of engineers are necessary in connection therewith. The relation of the locations of available sites to existing and prospective industries; the suitability of sites with respect to topography, soil conditions, climatology and existence of nuisances; the available means of communication and transportation; as well as the comparative estimated cost of development on different sites, are all factors in the consideration of which engineering principles must govern.

(Continued on page 221)

WATER WORKS SECTION

WATER RATES IN SMALL CITIES AND VILLAGES

By John Wilson, Consulting Civil and Sanitary Engineer, 300 First National Bank Bldg., Duluth, Minn.

According to the latest information the writer has at hand, there are 202 water works plants in the State of Minnesota, of which 195 are publicly owned and 7 privately owned. In view of the foregoing, the Minnesota Section of the American Water Works Association will be interested in water rates which apply particularly to municipally owned plants, said Mr. Wilson in addressing the recent annual convention of the section.

A municipality when operating a water works system is engaging in a commercial enterprise; and to be successful, it must furnish adequate service at reasonable rates, which must be in proportion to the service rendered and without discrimination.

Two Types of Service

The service rendered by a water works plant is of two distinct types; first, it must be ready to furnish water in comparatively large quantities under high pressure for short periods of time for the purpose of extinguishing fires; and second, to furnish ample quantities of suitable water for domestic purposes under moderate pressure at all times.

It is now generally conceded that all the expenses incident to the former should be borne by the village or city at large. It is possibly unfortunate that the method of arriving at the compensation for fire service has generally taken the form of hydrant rental, as the number of fire hydrants has but a remote relation to the value or cost of the service.

It has been estimated that 60 to 80 per cent. of the cost of water works plants in cities under 5,000 is incurred by providing reasonable fire protection.

Rate Determination at Crosby, Minn.

Two years ago the writer was called on to report on the matter of rates for the village of Crosby, Minnesota, which problem involved some unusual and interesting features.

Crosby has a population of approximately 3,500, and owes its existence largely to iron mining industries in the immediate vicinity.

The water works plant was installed in 1911 by a private company, and operated by them until two years ago, when taken over by the village.

The franchise under which the company operated provided, in case the village wished to acquire title to the plant, that a board of appraisers should be appointed to determine the value and price to be paid. In accordance with this provision, Mr. C. T. Harding, of Virginia, was selected by the company, the writer was appointed by the village and Mr. John W. Alvord, a past president of the American Water Works Association, was selected as the third member. The value of the plant, as fixed by the board was $75,680.

The plant at that time consisted of twelve ground water wells 70 to 80 feet deep, electrically driven centrifugal pumps, a 100,000 gal. elevated tank, about six miles of distributing mains 4 to 10 in. in diameter, and 34 fire hydrants.

The conditions which led up to the village taking over the plant were largely due to failing of private wells, due to mining operations, and many of the outlying districts were entirely deprived of water, the company in the meantime was naturally very reluctant to make extensions.

Immediately upon taking over the plant the village spent over $56,000 in extending the distributing mains and also installed 35 additional fire hydrants.

The first step in determining what would be a fair schedule of rates was to estimate the proportion of the cost of the plant chargeable to fire protection. It was accordingly estimated that 51.6 per cent. of the appraised value and 45.9 per cent. of the cost of extensions might justly be charged to fire protection and the remainder charged to commercial service.

The village had 356 consumers and 155 householders who had asked for connections as soon as the extensions could be completed.

The question naturally came up as to who should install the meters and lay the connection from the main to the curb box.

In connection with this, the writer suggested that the village assume the cost of these two items, inasmuch as the number of consumers was small compared with the amount of distributing main; that many of the householders were men of limited means, who would be tempted to carry water rather than connect with the mains were they required to bear all the expense; and, furthermore, one of the principal needs of the water department was paying consumers. It was also suggested that, in consideration of the village bearing this expense, all consumers should pay a service charge sufficient to cover the interest on the necessary investment and depreciation.

Authorities Cited

In support of these suggestions, he quoted the following authorities.

In the case of Samuel M. Gillmore vs. Hackensack Water Company, the New Jersey Public Utility Commission ruled as follows:

> The Board concludes that the Hackensack Water Company should take upon itself the burden of maintaining all such connections as lie within the public streets up to and including the stop cock.
>
> The practice of the company, requiring the consumer to pay for the installation of service pipe within

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the public streets and the stop cock, is disapproved as an improper and unreasonable charge.

Dated Dec. 7, 1915.

A similar ruling by the Wisconsin Railroad Commission was as follows:

> The question as to who should own meters appears to be settled. The only point to be decided here is whether or not services are a part of the facilities which the utility is expected to furnish. The logical conclusion seems to be that the utility should install and own services to the curb line. The utility, and not the consumer, has the right to occupy the streets, and all pipes laid in the streets should be the property of the utility, and we believe should be put in by the utility. The business of the utility is to deliver its product to the premises of the consumer. If the utility should own the mains through which water is carried to various sections of the city, it seems equally true that it should own all parts of the distribution system as far as the consumer's premises. The service pipe from main to curb is as much a part of the utility's distribution system as is the main itself. Both parts of the equipment have the same purposes—the delivery of water to the consumer's premises.

The California Railway Commission reached the same conclusion, 2 Cal. R. C. R., page 989, in which the Commission said:

> That it is the duty of a water company to supply service connections up to the property line, and meters, where meters are used, without direct expense to the consumer, seems clear both on principle and on authority. Such requirement seems entirely reasonable. The service pipe up to the property line and the meters, where used, are as necessary in the performance of the water company's duty to the public as its reservoirs, wells or mains. The consumer has no right to dig up the streets to lay a service pipe. That right belongs to the water company alone. It seems unreasonable to ask that the consumer should pay for service pipes and meters which are a part of the water company's system, which the consumer has no legal right to install and which are under the complete control of the water company.

Monthly Service Rates

The service rates suggested, which would be a regular monthly charge, in addition to regular meter rates, were as follows:

⅝ in. meter	40c per month
¾ in. meter	75c per month
1 in. meter	$1.25 per month
1¼ in. meter	1.80 per month
1½ in. meter	2.50 per month
2 in. meter	4.00 per month
2½ in. meter	6.00 per month
3 in. meter	8.00 per month
4 in. meter	12.00 per month

One advantage of a service charge is that it tends to regulate the department's income and thus aid in meeting current expenses, while graduating the charge according to the size of meter and connection protects the department against consumers demanding much larger fixtures than necessary.

Consumption of Water

As close as could be ascertained, the yearly consumption of water would be distributed as follows:

Measured by ⅝ in. meters	1,440,000 cu. ft.
Measured by larger meters	188,520 cu. ft.
Passing meter without registry	50,000 cu. ft.
Street sprinkling	290,000 cu. ft.
Drinking fountains	180,000 cu. ft.
Flushing sewers, etc	30,000 cu. ft.
Flushing trenches	10,000 cu. ft.
Testing meters	600 cu. ft.
Use in extinguishing fires	32,400 cu. ft.
Total	2,221,520 cu. ft.

It is very clear that the first three items should be paid for by the water consumer; the last one charged to fire protection, and the remainder should be charged to the village at large.

Unfortunately no means had been provided at the plant to determine the amount of water pumped. It was therefore assumed that the above would constitute about 60% of the water actually pumped and that 40% would be unaccounted for.

Annual Expense

The total annual expenses for everything connected with the department was about as follows:

Interest on bonds $130,000 @ 6%	$7,800.00
Interest on other indebtedness, $15,000 @ 6%	900.00
Clerk's salary, charge to Water Department	960.00
Superintendent's salary	1,800.00
Labor	600.00
Office supplies, postage, etc	500.00
Fuel	30.00
Meter repairs	100.00
Maintenance, supplies and depreciation	1,500.00
Electric current	612.50
Insurance	30.00
Telephone	25.00
Total	$14,857.50

It will be remembered that the extensions made to the distributing system were made necessary because of private wells becoming exhausted due to mining operations. The total number of houses to be served by these extensions was 331, while the number who declared their intention of taking water was but 155.

It is at once apparent that a rate for water which would yield a fair return on an investment such as incurred by these extensions would be unreasonable, and at the same time it would not be just or fair to place this additional expense on such consumers as the village already had.

The village was under moral obligations at least to contribute something to the relief of parties who had been deprived of well water. They were also engaging in a commercial enterprise, and should expect, the same as in any other business, to do so for a time at a financial loss.

It was therefore estimated a reasonable deficit over a fair return on these extensions would be $1,700 per year, which should be included in the proportion of the expense borne by the village at large.

From the foregoing data the rates which should be put into effect and the income to the water department would be as follows:

Hydrant rental, 79 hydrants @ $75	$5,925
Deficiency on fair return on extension	1,700

Water used by village @ 18c 100 cu. ft.....	1,000
Total due from village.....	$8,625
Service charge:	
400 5/8 in. meters @ 40c per month.....	$1,920.00
2 1¼ in. meters @ $1.80 per month.....	43.20
1 1½ in meter @ 2.50 per month.....	30.00
1 2½ in meter @ 6.00 per month.....	72.00
1 3 in. meter @ 8.00 per month.....	96.00
Total from service charge.....	$2,161.20
1,628,520 cu. ft. of water @ 25c per 100 cu. ft.	$4,071.30
Making a total inc. from private consumers of	6,232.50
And a total income from all sources of.....	14,857.50

In this way the village would pay 58% of the total annual expenses and the water consumers 42%.

The Wisconsin Commission ruled, in the case of Ashland, Wisconsin, that the city should pay 54.5% of all fixed charges; and in the case of Ripon, Wisconsin, that the city should pay 75% of all fixed charges; in which case it would seem that the distribution at Crosby would not be unreasonable.

Such items as clerk's salary were all charged to domestic service, while the fire service was charged with its share of interest on bonds, maintenance of fire hydrants, etc.

Rates in Effect in Minnesota Cities

The case of Crosby will illustrate fairly well some of the principles of arriving at proper rates in a given case. We will now briefly consider the rates now in effect throughout the state.

The following figures are necessarily not exact, but they are taken from about 140 towns and are therefore reasonably representative.

Fifty-seven percent of the water plants in the state receive nothing whatever from the municipality in the way of hydrant rental or payment for fire protection. Where hydrant rental is paid, it ranges all the way from $4 per year per hydrant to $140, the average being about $35.

Seventy-eight per cent of the towns pay nothing for water used for public purposes, such as street sprinkling, while of those who do pay, 69 per cent do so on a flat rate basis, without regard to the amount of water used.

In commercial service, about 44% are on a strict meter basis, 36% on a combined meter and flat rate basis, and 20% are on a flat rate.

The rates in most cases are on a sliding scale, decreasing as the amount of water used increases. The most extreme case is a town of a little over 3,000, where they have 21 different rates for water and 20 different rates of discount for payment of bills when they become due.

In most cases the revenue derived from commercial service is not sufficient to cover the department's needs, and certificates of indebtedness are issued. These certificates bear 6% interest and in many cases can only be disposed of upon a discount of about 10 per cent.

Paper of this kind is allowed to accumulate until a special levy in taxation is made or bonds issued for paying off the indebtedness.

The whole procedure is an expensive and extravagant way of doing business. In consideration of the present state of the money market, many towns would do well to revise their water rates and place their departments on a cash basis.

Legal Features in Connection with Installation of Service Mains

A full legal discussion relative to who should bear the cost of installing service mains and as to the ownership of such mains when installed would of itself necessitate a very long paper. The following discussion applies particularly to villages and municipally owned plants.

As to whether the consumer or the municipality should bear the cost of installing the service mains, the Minnesota laws very clearly leave this to the discretion of the governing body, who may require the consumer to pay part or all of the expense, or, on the other hand, may install the service entirely free of charge, as they may deem advisable.

Our Attorney General's office has handed down an opinion that it is customary in this state to consider the service pipe from the main to the shut-off box a part of the main.

Section 1313 of the 1913 statutes reads as follows:

"The village council of any village now or hereafter having a water works system shall have power to levy a special tax upon all property especially benefited thereby, in front of which any water main shall be laid."

Section 1314 reads:

"The same may be divided up into five annual installments and shall not exceed the sum of one dollar per lineal foot of pipe laid in front of each lot or parcel of land, against each tract of land, and the same shall be a lien upon such land from the time that the tax is levied by the village council as hereafter provided, provided however, that no lot or parcel of land shall be subject to such tax after five annual assessments have been levied, except as hereinafter provided."

Section 1326, Supplement 1917, a very lengthy section, reads in part as follows:

"It shall be the duty of every owner or occupant of any abutting property platted into lots and blocks having dwelling house or business property situated thereon to install a toilet in said dwelling or business property, and make connection thereof with the water and sewer in the street or alley adjacent thereto." * * *

The section then provides that in case of refusal the village may install such connection and assess the entire cost to the property, and that the payment of such assessment may be made in three annual installments.

It is thus very evident from the statutes themselves that the main and the service pipe are considered as two distinct features of the system, the assessment for the first being limited and spread over a term of five years, while the assessment for the latter is limited only by the cost, and must be paid in three years.

However, the Attorney General's office may not be so far wrong after all, for when we come to the ownership of the service pipe, or vested title therein, it seems a settled question that the village or utility has title to both, notwithstanding the fact that the consumer may have paid in full the cost of installing the service, and is in this way considered an essential part of the main.

Mr. John W. Alvord, in a paper read before the Second Annual Convention of the New Jersey Utilities Association, cites the case of the Knoxville Water Company, wherein in valuing the property for a rate case the com-

pany presented to the court the claim that all services were the property of the company, whether provided at the company's expense or at the expense of the private consumer. On this point the master's opinion was as follows:

"In the matter of services there is much difficulty, not as to price, for the proof seems to be with complainant (water company). Defendant's plumber witnesses when under cross-examination rather confirm it. Defendant says, and proof shows that consumers were made to pay for all but 423 of the 4,323 services stated. * * * Complainant says it actually owned these connections, * * * they are in the streets and cannot be changed by the consumer. In case of competition this consumer would not be permitted to connect this with another main. * * * The contention is that no matter how obtained, the property is theirs and the charge heretofore made was an additional charge for water at that time, etc.

"I see no way of resisting this conclusion, although I confess to much sympathy with defendant's contention that the citizens having paid for it should not be charged an interest on its value.

"The master then allowed the sum of $38,714 for the service pipes.

"The U. S. Supreme Court, in passing upon this case, examined the allowances of the master in detail, making no deductions from the master's findings on the value of services. The Supreme Court refers to the service pipes in the following language:

" 'The first fact essential to the conclusions of the court below is the valuation of the property devoted to the public use, upon which the company is entitled to earn a return. That valuation ($608,000) must now be considered. It was made up by adding to the appraisement, in minute detail, all of the tangible property, the sum of $10,000 for organization, promoting, etc., and $60,000 for going concern value. * * * The cost of reproduction is not always a fair measure of the present value of a plant which has been in use for many years. The items composing the plant depreciate in value from year to year in a varying degree. Some prices of property, like real estate, for instance, depreciate not at all, and sometimes, on the other hand, appreciate in value. But the reservoirs, the mains, the *service pipes,* structures upon real estate, standpipes, pumps, boilers, meters, tools and appliances of every kind begin to depreciate with more or less rapidity from the moment of their first use.'

"It will thus be seen that the master included the service pipes in his valuation on the theory that title was in the company, although paid for by the consumer, without any allowance in the reproduction cost for the contribution, and that the United States Supreme Court, by inference at least, affirmed his report as to the service pipes being the property of the water company."

Mr. Alvord also referred to a case presented to the United States Supreme Court in the Washington Gas case (Washington Gas Company's, District of Columbia, 161 v. s. 316,326). Here the company wish to disclaim all title to the service pipe on the grounds that it had been paid for by the consumer, and thus avoid liability because of a defective service box. Mr. Justice White, speaking for the court, said:

"The plain object contemplated by the formation of the gas company was the supplying of gas to be by it manufactured to consumers, and it is obvious that this could not be done without making a connection between the street mains and abutting dwellings. When such connections are made with the mains they receive from them and convey into dwellings highly inflammable material, which flows by an uninterrupted channel from the mains themselves. It must therefore necessarily have been contemplated that such connections with the mains as were from their very nature incidental to an inseparable connection with the consumption of gas should be a part of the apparatus of the gas company, and be under its control, rather than under that of the city or the property owner.

"Indeed the control by the gas company of the connection from its mains to the point of use is as absolutely necessary to make it possible for the company to carry out the very purpose of its charter as are the retorts and mains.

"Moreover, the provisions of the charter show that it was thereby contemplated that the connection between company's mains and the places where the gas was to be consumed should be made by the gas company, and become a part of its apparatus.

"The charter does not confer the power upon those desiring a supply of gas, but gives such power to the company. * * *

"We conclude, therefore, that the duty was imposed upon the gas company to supervise and keep the gas box in repair. This duty not only did not conflict with the charter of the company, but, on the contrary, is sanctioned by its tenor and is imposed as an inevitable accessory of the powers which the charter confers.

"Nor do we think that this duty was affected by the circumstances that the cost of the labor and materials used in the construction of the connection and gas box was paid by an occupant or owner of property, who desired to be furnished with gas. As the service pipe and stop cock was a part of the apparatus of the company and was used for the purpose of its business, it is entirely immaterial who paid the cost or might in law, on the cessation of the use of the service pipe and gas box by the company, be regarded as the owner of the mere materials.

"Certainly, it would not be claimed that if the box and its connection became so defective or out of repair that gas escaped therefrom and caused injury the company could legally assert that it was under no obligation to take care of the apparatus because of the circumstance that it had been compensated by others for its outlay in the construction of the receptacles from which the gas escaped.

"The argument seeking to distinguish between the service pipe and other appliances of the gas company and the gas box so as to make the company liable for one end and not for the other is without merit. All these appliances were parts of the one structure put in position and used together for the purposes of the company."

The conclusions reached after investigating all available court decisions are that the consumer in paying all the costs incident to installing service mains does not acquire ownership, but is simply making a contribution, paying in advance for anticipated services or paying in part for the enhanced value of his property because of such installation.

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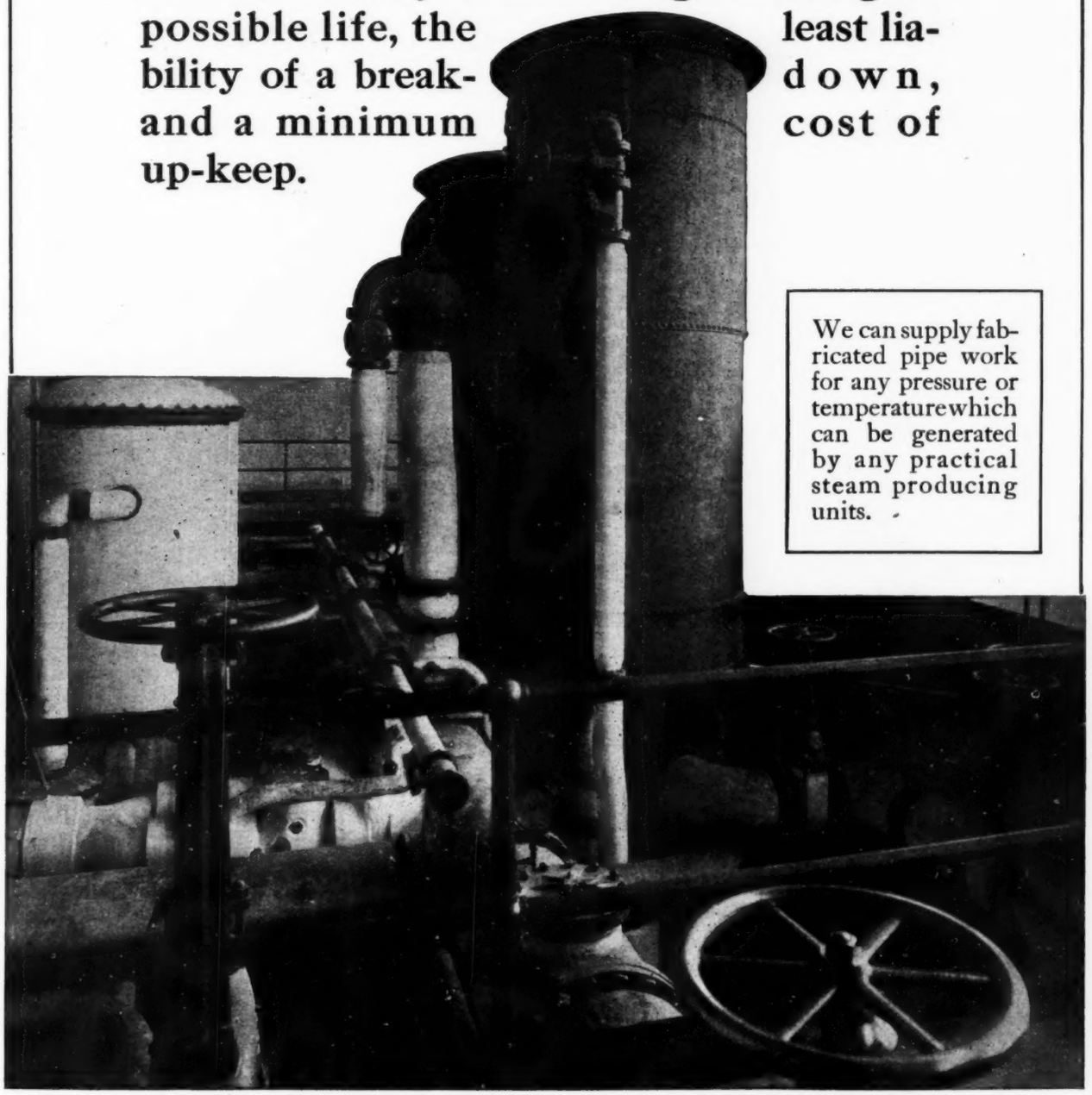

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By assuming the burden of installing service mains the consumer supplies a portion of the necessary capital, and is entitled to consideration to that extent in the rates charged for water service.

The Minnesota laws, in leaving the question as to who shall furnish the capital for installing service mains, the consumer or the village, to the discretion of the governing body, seems entirely proper, for in this way the work can be financed by the party who can do so most advantageously.

APPLICATION OF COPPER SULPHATE TO BASIN WALLS FOR CONTROL OF ALGAE

By George F. Gilkison, Chief Chemist, Water Department, Kansas City, Mo.

The object of this article is not to introduce a new method for the control of algae, but rather to show how the Kansas City, Mo., Water Department has, by changing the application of copper sulphate from the water to the basin walls, been able to control this annoying growth in the clear water basins.

Algae Troubles

Kansas City takes its water supply from the Missouri River at the Quindaro Pumping Station, 10 miles above the city. This station has a basin capacity of 90 millions gallons. The water is purified by sedimentation aided by coagulation and chlorination. It is then delivered to the Turkey Creek Station, which is the distributing station. We have seven storage basins with a total capacity of 38 million gallons, located at different points throughout the city. It is in these basins that the algae growth causes the most annoyance. The basin becomes very unsightly, due to the fact that Spirogyra predominates and appears in long filaments throughout the basin. It also causes trouble in the meters by stopping up the strainers. At times offensive odors are generated due to the development of Anabaena and other Blue Green Algae.

First Control Method Tried

The method first used to control this growth was to scrub the walls with long handled wire brushes. This was not successful due to the fact that the algae was torn lose from the walls and a large amount of it floated in the water and would attach itself to the wall again at the first opportunity.

Second Method Tried

The next method we tried was taking a known amount of copper sulphate in a sack and by means of a rope attached to it, dragging the sack along the wall on which the algae was growing. The disadvantages of this method were that the current caused by the sack would carry the copper sulphate solution away from the wall and the strength of the solution being applied was unknown. This method also required a great deal of time as the sack had to be drawn back and forth over the same wall to kill the algae growth.

Applying Copper Sulphate With Coagulant

To overcome the uncertainty of concentration, an experiment was made at the Quindaro Station in which the copper sulphate was applied with the coagulant to the water. Copper sulphate being incombatable with aluminum sulphate, the two were dissolved in the same solution and applied to the water as it passed over the weir by means of a perforated pipe line. The volume of water passing over the weir was known. We added copper sulphate at this point and in this way were able to calculate the parts per million in the basin. We started with 0.25 parts per million and progressively increased this to 1½ parts per million. There was no apparent action on the wall growth until the concentration of the copper sulphate reached 1 part per million and at that concentration the algae at the end of the basin at which the copper sulphate was being applied was killed, but 1½ parts per million was necessary to clear the far wall. This experiment was followed by an enormous increase in the bacterial count in the basin. The alkalinity of our water at the time of this experiment was 185 parts per million. While chemical analysis was not made on the effluent water from this basin, I feel safe in saying that most of the copper sulphate was lost by reaction with the alkalinity of the water. The following varieties of fish were present in the basin; cat fish, carp, perch, drum, shad, and buffalo, none of which were killed.

Direct Application to Basin Walls

Copper sulphate is now used in a known strength solution, and is applied directly to the algae growth on the basin walls. The water elevation in the basin to be treated is brought down below the algae line (which is about 6 ft. below the normal elevation in our basins). This leaves the algae clinging to the wall. A paint spraying pump is attached to an 8 gal. keg which is mounted on wheels and equipped with a handle. A 5 per cent. aqueous solution of copper sulphate is made by dissolving 6½ lbs. of copper sulphate crystals in 10 gals. of water and poured into the keg, and while one man operates the pump another man directs the flow of the solution which is delivered in a fine spray. After an hour's time the walls are scrubbed with a wire brush and the basin is again filled to normal elevation.

One gallon of this solution will cover 125 sq. ft. of wall surface and can be applied by two men with a spraying machine in four minutes.

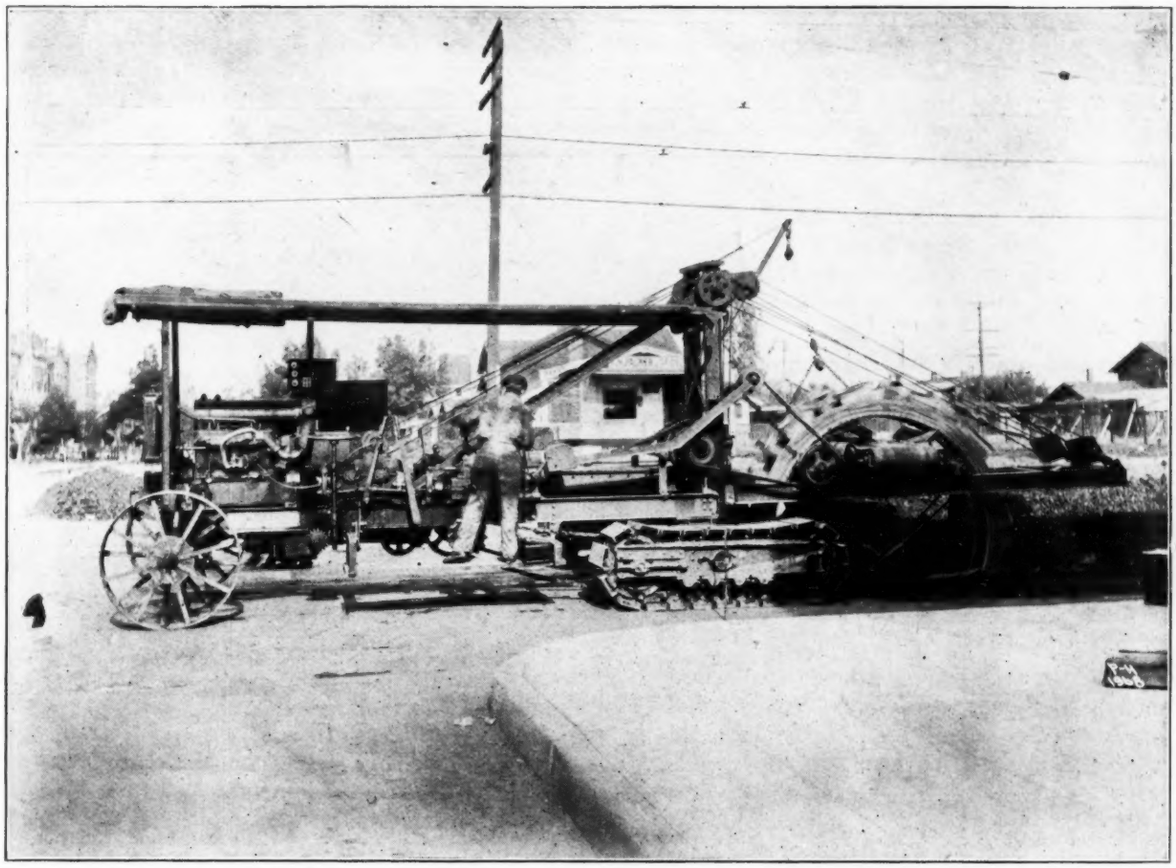
We have found that by carrying out this method every two months during the warm weather we are able to keep our basin walls comparatively free from algae.

This paper by Mr. Gilkison was presented at the 1920 annual convention of the Iowa Section of the American Water Works Association.

SOME ENGINEERING AND ECONOMIC FEATURES OF THE MUNICIPAL ELECTRIC SYSTEM OF LOS ANGELES

By E. F. Scattergood, Chief Electrical Engineer, Department of Public Service, 645 So. Olive St., Los Angeles, Calif.

The development by the City of Los Angeles, of hydroelectric power along its aqueduct and on natural streams tributary to its aqueduct water supply and its distribution within the city, was originally planned that electricity might become a convenience, rather than a luxury, in the domestic and commercial life of the city and that the establishment of industries beneficial alike to the city and the whole southwest might be encouraged by an abundant supply of cheap power in addition to water, harbor



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and transportation facilities. On account of recent developments in the fuel situation and the unprecedented demands for power, it now becomes a matter of duty and necessity that Los Angeles should both enlarge and speed up its power development program that serious shortages of power may be avoided.

The water supply for the Los Angeles Aqueduct is taken from streams in the Owens River watershed on the esatern slopes of the Sierra Nevada Mountains, a distance of 250 miles from the center of the city, and its ultimate capacity is sufficient to sustain a population of between 2,000,000 and 2,500,000 people.

The aqueduct intake in the Owens Valley, is approximately one-half mile higher than the point at which it discharges its water into receiving reservoirs at the northerly limits of the city and there are four stretches, totalling 12 miles in length, along the aqueduct where the grades are in excess of the requirements for gravity flow. The power development plans of the city provide for the construction of power diverting tunnels and waterways at these locations, similar to waterways for power development along natural streams, and thus developing 115,000 horse-power.

The project also contemplates the development of 100,000 horse-power from the natural streams tributary to the aqueduct water supply and the city is at this time seeking additional water power opportunities sufficient in all to meet the probable needs for such reasonable period as ten to twelve years.

Nine miles of the power waterways along the aqueduct, consisting of rock tunnels, and leading to the two principal aqueduct power sites have been constructed, together with power storage and regulating reservoirs above and below, and a partial plant installation of 37,500 horsepower at one of the sites, has been completed and in operation since April, 1917, and of 28,000 horse-power at the second site, since the first week in July of the present year.

Municipal distributing lines in portions of the city are serving 11,000 light and power consumers and, pending the city's proposed purchase of the Southern California Edison Company's distributing system within the city limits the company is operating the same as an agent of the city and the bulk of the necessary power is being supplied by the municipal hydro-electric plants. An issue of $13,500,000 of power bonds was authorized in June, 1919, $11,000,000 for the purchase of the Edison Company system and $2,500,000 for the construction of additional power plants. These bonds have been tied up in litigation ever since by opposing selfish interests, but it is expected the funds may be available within a few months.

During the past two years of low stream flow in California the flow in the city's aqueduct has been increased to an average considerably in excess of that required for domestic and agricultural purposes in order to help out the power supply generally in the southern portions of California and the San Joaquin Valley, the city having maintained a high flow during the greater portion of the winter of 1919-20, in order to minimize the shortage in the San Joaquin Valley, until the rains gave relief. The increased flow in the aqueduct and the completion of the city's second large plant last summer has made possible practically the elimination of all loss from power shortage in the southern end of the state, both inside and outside of Los Angeles.

Rates for electric service in Los Angeles are comparatively low, the reason for which is to be found, primarily, in the advantage which a large municipality has over a private corporation on account of its greater financial credit and the simplicity of its working organization resulting in large savings in interest and in general expense, also resulting in a higher degree of engineering efficiency in municipalities in which the appointment of competent executive engineers is insisted on; plan carefully, build well and thus secure good service without undue maintenance and duplication of investment.

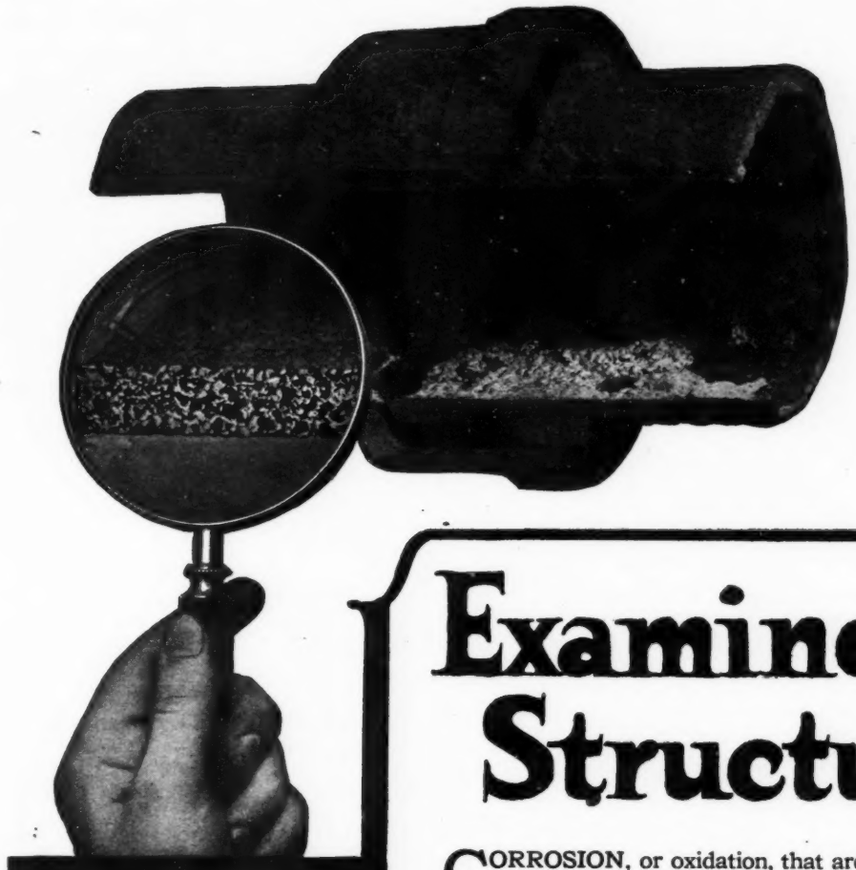
The large increases in rates charged by the companies for electric service in California are, of course, in part the result of the increased cost of labor and material but they are due in large part to the limited credit of private electric utilities, resulting in rates of interest as high as 8 or even 10 per cent. on short term securities. In some instances the companies are asking that rates be fixed on the basis of the earnings necessary to enable them to borrow money for the construction of additional plants rather than on the basis of existing capital investment, and the State Railroad Commission, in exercising control over the companies' rates must choose between a continued power shortage and the establishment of such rates as may result in the construction of additional plants.

Ordinarily small communities cannot develop hydro-electric power to advantage except by the formation of utility districts and it is manifest that the investigation by the state of water conditions and the possible formation of water districts in California, which is very properly being urged, should include water power as well. It is not apparent why the state itself as a matter of duty, should not at this time develop a large amount of the hydro-electric power now lying idle in the Sierra Nevada Mountains. This could be done without injury to any existing investment but on the contrary should result in a measure of relief and, I believe, would be so regarded by most companies, as the power could be distributed through existing agencies without creating any considerable disturbance or economic waste.

It makes but little difference who develops the power if it is developed in sufficient quantities and cheaply, as water power will never be hoarded while the supply for other communities is exhausted. Large municipalities can develop hydro-electric power to advantage and should do so in order to reduce the amount of money which the private corporations must borrow and the tendency toward increased rates.

The City of Los Angeles, following particularly the lead of its Chamber of Commerce, in the establishment of a municipal harbor and an ample water and power supply is not acting entirely through selfish motives by any means, but recognizes the fact that the welfare of the southwestern communities generally is linked with its own and that their interests are interdependent in large degree.

The City's Power Bureau is not of choice indulging in any propaganda of an argumentative sort on the question of municipal versus private ownership, but some people favoring private ownership of public utilities and, therefore, much disturbed by the disparity between the



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electric rates within and without the City of Los Angeles, insist on accusing the Los Angeles Bureau of Power and Light of being unfair and lacking in frankness and truthfulness while they alone are indulging in such practice and they alone appear concerned about the relative showing of municipal vs. private ownership. For your information in this connection, I wish to add the following:

(a) The claim often made that the city's power project profits unduly from its aqueduct investment is erroneous in that the power funds have been used for construction of waterways and reservoirs and the power plans contemplate the further construction of waterways and reservoirs fully equal to the corresponding features for the important power developments of the companies on natural streams along which they have selected and developed only the more advantageous sites.

(b) The accounts of revenue and expenditures of the Power Bureau are kept in strict conformity with the system of accounting established by our State Railroad Commission.

(c) The municipal rates for electric service in Los Angeles prior to October 11th, of this year, provided a base rate of 5 cts. per K. W. Hour for electric lighting, scaling down to 1.8 cts. per K. W. H. for all energy in any one month in excess of 3,000 K. W. H., and provided a base rate for electric power of 4 cts. per K. W. H. scaling down to 0.76 cts. for a consumer using 1,500,000 K. W. H. or more per month, with discounts up to 16 per cent. for the higher load factors. Assuming the city in possession of and operating the Edison distributing system in the city combined with its own during the calendar year 1921, the earnings, with those rates charged to all consumers, would be sufficient to give a surplus of $400,000 in excess of operating expenses and proper allowances for fixed charges on the total capital investment, including the $11,000,000 proposed to be paid to the Edison Company. The city is receiving as good return from its industrial power as from any other service and is not "subsidising" power consumers.

(d) The city built its second large hydro-electric plant, completed last July, believing that revenues from the power bonds authorized in June, 1919, would be available by the time the plant was completed, but the prolonged litigation made necessary an increase, temporarily, of 12½ per cent in the municipal rates in order to enable the Power Bureau to meet its obligations, having no other source than revenue from which to pay for the plant. For the same reason the Board of Public Service Commissioners, having charge of the water and power projects of the city, has been compelled, temporarily, to abandon its policy of providing for interest and sinking fund requirements on power bonds out of the power revenues and the taxpayers of Los Angeles have helped build a plant which has benefited other communities as much as the city in preventing power shortage.

It is unthinkable that our statutes continue to permit selfish interests, in a wholly irresponsible manner, to tie up issues of bonds, approved by two-thirds of the people for the establishment of municipal utilities, as has been done three times in succession with the Los Angeles power bonds. Such interests should be made responsible for the resulting damage, in event of failure of their suits, or other provisions should be made to prevent acts so detrimental to the public interest. This may become a question of great importance to all communities in connection with state, municipal or district utility matters and merits careful consideration.

This paper by Mr. Scattergood was presented at Chico, Calif,, recently, before the League of California Municipalities.

ANNUAL MEETING MINNESOTA SECTION AMERICAN WATER WORKS ASSOCIATION

The Duluth meeting of the Minnesota Section of the American Water Works Association was one of the best the section has yet held from the standpoints of attendance and interest shown in the discussion of the papers presented. The following notes on the meeting were contributed to Municipal and County Engineering by a valued Minnesota reader:

Mr. C. J. Sullivan suggested in his paper that the water purification plant operators in Minnesota should be registered or licensed, so as to insure competent operation of the plants. This idea was favorably received by those present.

Mr. E. W. Kelly described the Duluth water works and the problems encountered in providing water for a city that has such a variation in elevations as has Duluth. The city is divided into four zones, each of which is served by its own reservoir and pumping station.

The Commercial Club provided a most enjoyable luncheon for the visiting members, after which there was an automobile drive to the Aerial bridge, the main pumping station, and along the beautiful boulevard system that extends along the bluffs.

Mr. John Wilson described the methods used in arriving at an equitable rate for water supplied to small cities and villages. Mr. Wilson presented a paper that was up to his usual high standard. A resolution was passed asking Mr. Wilson to extend the data presented. The complete paper is published in this issue of Municipal and County Engineering.

Mr. William C. Lounsbury gave a most interesting description of difficulties encountered in providing a pure water supply for the City of Superior, Wisconsin. The water is obtained from wells located on Minnesota Point and is then pumped across the bay to the Wisconsin side. He illustrated his talk with lantern slides.

"The Thawing of Frozen Water Pipes" brought out considerable discussion, as it appeared to be a subject in which all water works plants in Minnesota are interested.

"Keeping Chlorine Machines in Operation" was omitted from the program because of the lateness of the hour. It will be presented at the next meeting.

"The Use of Chlorine for the Sterilization of Water Supplies and Its Effect Upon Their Potability" was the last subject discussed. A brief resume was given by Lewis I. Birdsall of the history of water sterilization with hypochlorite of lime, the advent of the liquid chlorine machine, the use of chlorine for water sterilization during the war, and its almost universal acceptance at the present time as a means of water purification. Stress was laid on the necessity of competent supervision and careful laboratory control of chlorine plants, and it was also pointed out that duplicate installations and extra repair parts are highly essential.

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A resolution was passed urging the State Legislature and the Governor of Minnesota to grant an increased appropriation for the Sanitary Division of the Minnesota State Board of Health in order that it may extend its splendid work of supervision of the water supplies of Minnesota.

THE RELATION OF HOUSING TO ENGINEERING

(Continued from page 210)

Development of Town Plan

Where a number of houses are to be constructed in a group, their arrangement with respect to one another, and the provision of the necessary traffic routes and open spaces give additional opportunity for the co-operation of the engineer. The services of the realtor will be of importance in connection with subdivision for sale or renting; and the advice of landscape architects will be required in providing park areas, planting, the grouping of buildings in civic centers and other accessories which are needed to make the development attractive. However, it is the engineer who must make the necessary topographic and land surveys; who must work out the basis of districting and zoning for restricting the use of property into lots and blocks; and who must locate, in accordance with the requirements of traffic, main thoroughfares, secondary streets and other features of the town plan.

Streets and Pavements

Houses are only one part of a housing development, which could not be used without the passageways by which their occupants pass to and from them, and to and from their working places. The designing of these ways is strictly an engineering problem, including the determination of widths, grades and cross-sections; the provision of drainage; the selection of materials; and the designing of sidewalks, curbs and gutters and other accessories. The close relation of clean, paved streets to public health commends this phase of the relation of engineering to housing to the special consideration of the sanitary engineer.

Water Supply

The water supply of the housing group is, of course, the special field of the sanitary engineer. The determination of the quantity of water required, the selection of a source of supply and the design of suitable purification, pumping and distribution works all are within his field.

Sewerage and Drainage

Of no less importance than the supply of water to houses is the provision of facilities for removing waste water, both that which results from the use of the water supply, and that which falls as rain. The design of sanitary and storm sewers and of sewage treatment and disposal works are again the special field of the sanitary engineer.

Refuse Disposal

The removal of solid refuse, including garbage, rubbish, ashes and street sweepings, and their final disposal by burying, feeding, reduction or incineration are all part of the service for the furnishing of which the sanitary engineer must be called upon in connection with the solution of the housing problem.

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While not of especial sanitary significance, these public utilities, which are so important for the convenience of modern city residents, constitute a still further field for the activities of the engineer, in connection with housing.

Houses and Plumbing

The design of the house is the special field of the architect. However, the health of the occupants depends upon the provision of sufficient air space and of suitable means for entrance of light and air. The sanitary engineer has therefore been able to perform useful service in connection with the development of satisfactory standards with respect to these features. An additional feature of house construction which is of great sanitary importance is the house plumbing. The value of the all-important sanitary services of water supply, sewerage and drainage would be lost without the pipes, fixtures and other apparatus required for distributing water within the house and for accordance with scientific principles and natural laws as it is that the water pipes and sewers in the ground shall be designed in accordance with good sanitary engineering practice. Great economies in house construction are also removing liquid and water-carried waste. It is just as important that these pipes and appliances be installed in possible where the architect takes advantage of the sanitary engineer's most modern practices.

Construction

The organization, direction and supervision of construction on housing projects are wholly within the field of the engineer. The sanitary engineer also has especial interest in the sanitation of construction camps and the provision of temporary water supply and other temporary sanitary facilities.

Management

Where large groups of buildings are constructed and maintained as separate communities, skilled managers are required to handle the maintenance, rental and sale of houses, the operation and maintenance of water supply and sewerage, the supervision of garbage and waste removal, the upkeep of roads and pavements, the care of public grounds and parks and the administration of public health and police affairs. Executive ability and human qualities are of more importance in determining the success of a town manager than are professional training or experience; but where a large development has been constructed, it would appear that, provided he has the other necessary qualifications, one of the engineers who has taken an active part in the construction would probably be as suitable as anyone for the position of manager.

Regulation

Although, under present conditions, the elimination and prevention of undesirable housing conditions by public regulation has become a less prominent feature of housing work than the construction, which is so urgently needed, such control nevertheless remains an essential part of the housing program and continues to require the best efforts of some of our most capable sanitary engineers. The very shortage of houses has itself caused an increase of congestion in our cities which calls for more than usual sympathy and intelligence in the administration of housing regulations, and even houses which are now constructed in accordance with the best sanitary practice must be properly managed and maintained under public supervision if they are not to degenerate into slums. The importance of reducing construction cost also calls for a reconsideration of building and housing codes, with a view to attaining economy without sacrificing any essential sanitary aims. A wide field of usefulness for the sanitary engineer is therefore open in this direction.

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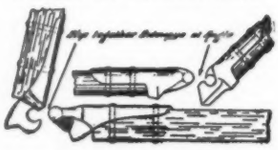

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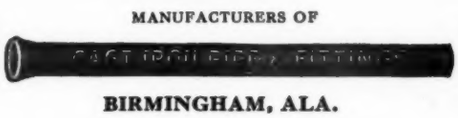

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CONSTRUCTION NEWS AND EQUIPMENT

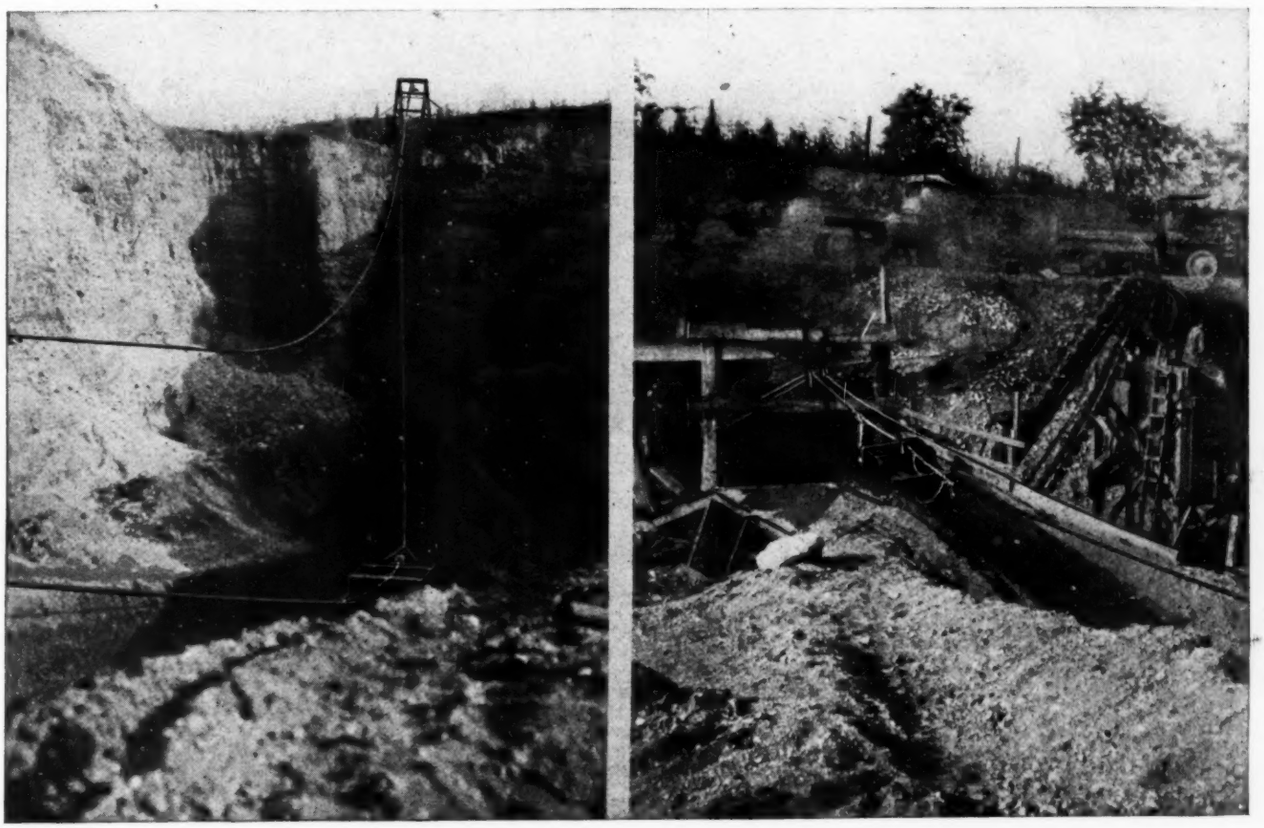
COUNTY ROAD COMMISSIONERS SUCCESSFULLY EMPLOY POWER DRAG SCRAPER IN WORKING GRAVEL BANK

The results obtained by the Cass County, Michigan, Road Commission this season by discarding teams and slip scrapers in favor of a mechanically operated drag scraper should be of interest to all road commissioners and contractors who are working small gravel banks.

The Cass County gravel deposit is a ridge about one-half mile long, running back from the main highway midway between Cassopolis and Dowagiac. As the result of several seasons' operations with teams and slip scoops the end of the ridge near the road was gradually cut down and a pit about 50 ft. in diameter had been created when the commission decided last July to increase the output of their pit and at the same time reduce the cost of excavating and handling the gravel by installing a power scraper.

The equipment previously used—a "Good Roads" portable screening plant, loading hopper, small jaw crusher and traction engine to drive the crusher, elevator and screen—was moved into the center of the pit and the new equipment, consisting of a 1/3 cu. yd. Sauerman Bottomless Power Scraper operated by a Clyde 6¼x8 double-drum, double-cylinder steam hoisting engine, was set up in a position to enable the scraper to excavate for a distance of several hundred feet into the ridge and convey the excavated material to the loading hopper at the screening plant.

At the end of its first two months of operation the power scraper had opened a new cut about 20 ft. wide and 30 ft. deep for a distance of about 100 ft. into the ridge. According to Mr. D. P. Smith, county road superintendent, who laid out and directed the installation of the equipment, the power scraper is accomplishing the work that would require a half dozen team scrapers and the cost of operating the power scraper is much less than the expense of handling the same work with teams.



VIEWS ILLUSTRATING THE USE OF A POWER DRAG SCRAPER BY THE CASS COUNTY, MICHIGAN, ROAD COMMISSIONERS IN WORKING A GRAVEL BANK.

The entire operating expense of the scraper is $14 per day, including coal, light repairs and the wages of the hoist engineer, who also acts as fireman. The daily cost of getting out a smaller amount of material with

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teams and scrapers before the power equipment was installed was $40 per day. The daily yardage handled by the power scraper has averaged 125 cu. yds., which is all the screening plant can take care of in 10 hours. The scraper cannot be operated continuously on account of the limited screening capacity, and could excavate and convey 250 cu. yds. per day under ideal conditions, according to Mr. Smith.

The accompanying illustrations give a good idea of the Cass County operations, and one photograph in particular shows the difficult nature of the digging, which is mostly in gravel so firmly packed that it will not yield to an ordinary plow pulled by a team of horses.

THE DEVELOPMENT OF STEEL FORMS AS USED IN ROAD CONSTRUCTION

By W. J. Savage, Manager of Sales, The Heltzel Steel Form & Iron Co., Warren, Ohio

When steel forms for road building and similar uses were originated and introduced to contractors to displace the wood forms then in use, the first objection to them mentioned was their weight, the word "steel" causing, in golf terms, a "mental hazard" which was not overcome without considerable effort. This erroneous impression prevailed for a time, but soon foresighted contractors realized the saving due to steel forms in setting,

FIG. 1.—ILLUSTRATES METHOD OF SUPPORTING BACK RAIL, ALSO USED IN SUPPORTING ROAD RAIL UP TO 1916.

and recognized the elimination of all other disagreeable features such as warping, buckling, loss of mixture, etc.

The first practical steel form for use in building roads and the like was brought out in 1909 by Mr. J. N. Heltzel, now president of the Heltzel Steel Form & Iron Co., Warren, Ohio. This form was made of No. 14 gauge open hearth steel, given double depending flanges both top and bottom of the rail, and supported by a steel angle stake with a clip riveted flush to top, upon which to hang the rail. Hence the term "Heltzel Hanging System." To form a continuous rail, sleeves were fastened to each rail, and the succeeding form, joined upon this sleeve.

This form proved an instantaneous success. Perfect workmanship was secured, and the strong yet light steel form, permitted a smooth operation of the strikeoff, preventing a wave finish to the road, a defect which was difficult to eliminate where wood forms were used. It was noted the forms stood up well under the rough handling, yet it was decided to increase the gauge material to eliminate any possibility of the form bending or buckling.

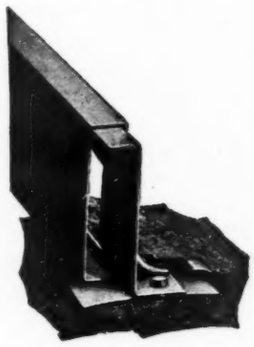


FIG. 2—PEDESTAL SUPPORT INTRODUCED IN 1916. Heltzel Hanging System Still Adhered to; Also Shows Joints Formed by Rails Butting Together on Pedestal. Finishing Machines Used on This Rail With Satisfaction.

The following season, an increase to 13 gauge was decided upon, and as years went by, the gauge material used was increased to No. 12, naturally giving greater strength to the form. However, the same double depending flanges on the forms were retained, eliminating bending of the form. Close observation was continued for improvement and in 1917, when heavier strikeoffs and templates were used, it was decided to change from the stake support to a pedestal. It was on this type form that the first test of a Finishing Machine, for building Monolithic Brick roads, was made and although the machine vibrated somewhat, the forms held up admirably.

Up to this date the forms were manufactured in 12-ft. sections, and in heights ranging from 5 to 9 ins., but it

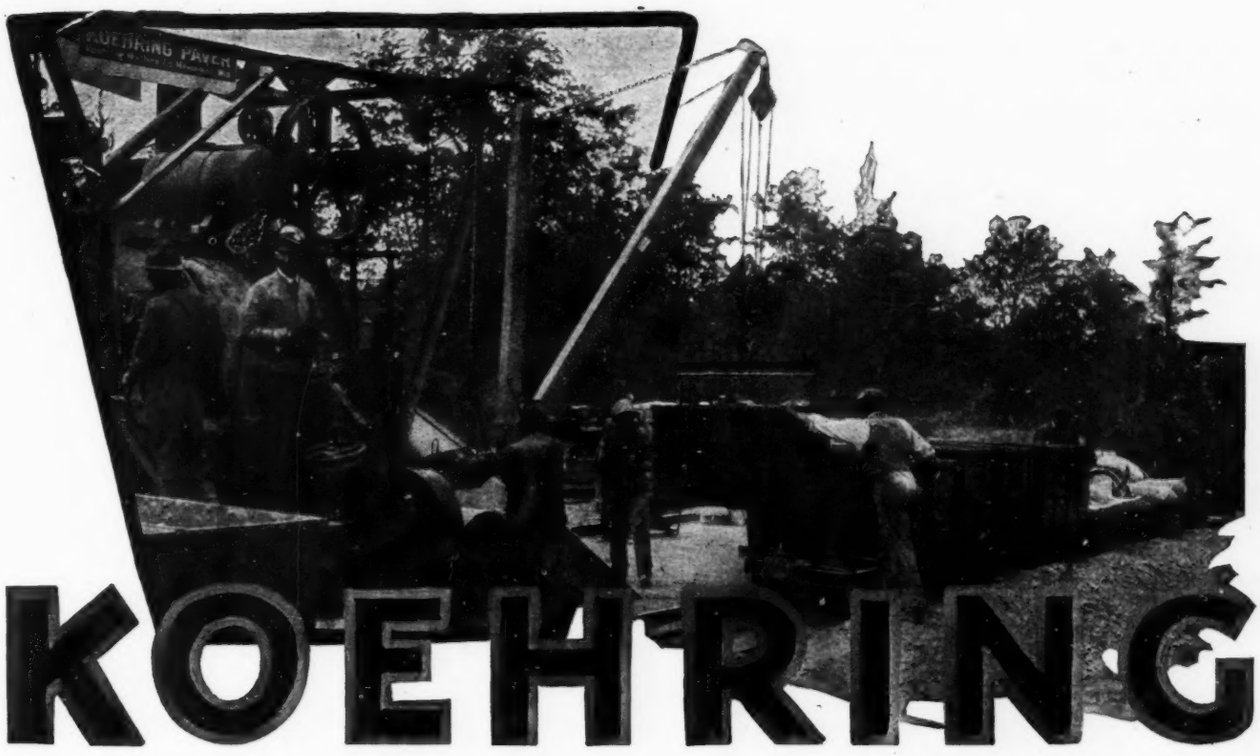
FIG. 3—STRAIGHT PEDESTAL. Same as Shown in Fig. 2, to Support Light Rails With Narrow 2-in. Flange Top and Bottom.

was decided to reduce the length to 10 ft., permitting a closer setup of the pedestals, and securing more rigidity. This same type of forms was also used with complete success under other finishing machines in the construction of concrete roads.

Upon close observation of the action of these finishing machines on steel forms, further improvements were deemed necessary resulting in the production of heavy duty forms.

Heltzel Heavy Duty Road Forms

The bottom flange of the rails was increased from 2 ins. to 4 ins. and the material used was increased from



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12 to 10 and later to 9 gauge. This latter gauge, at the present time, under all tests and conditions has proven sufficient to withstand the weight, vibration and action of all mechanical finishing machines, and the forms are so guaranteed by the company.

The Pedestal

The base plate of the pedestal was increased in size, heavy 3/16 plate now being used, and to give the improved forms a proper support, the design of the pedestal was changed as shown in one of the accompanying illustrations, permitting the rail to rest on the base plate, and preventing it from leaning or buckling under the vibration and strain of the machine, and to prevent sinking when the sub-grade is soft. As it is now manufactured, the rail will withstand a live load of three tons.

The upright is made of heavy pressed steel, 5½ ins. wide, reinforced with a pressed rib in the center and further strengthened with an extra depending flange to

FIG. 4—ILLUSTRATING HELTZEL LIGHT RAILS WITH STRAIGHT PEDESTAL SUPPORT.
Same as Shown in Figs. 2 and 3.

support the road rail. It is riveted to the base plate, which is punched with a slot, through which a flat stake is driven to hold the pedestal in place and prevent creeping of the forms.

In addition to the bearing surface obtained from the increased width of the bottom flange of the rail, are the 70 sq. ins. of the base plate on the pedestal. Naturally, this bearing surface prevents the forms from sinking in a soft sub-grade. A total bearing surface of 522 sq. ins. is thus obtained.

Another strong feature of Heltzel Steel Forms, and one noticed upon the most casual observation, is the total absence of any cuffs, rivets, or supports. There are no couplings of any kind and this eliminates what is known as right hand or left hand rails. Perfectly plain—severely so—all forms may be rapidly set and no time lost in determining upon which side of the road the rail is required. On tests it has been proved a saving of $3 may be made on every thousand feet of forms set, as compared with wood forms or others now on the market. The most unskilled laborer can set Heltzel Forms due to this simplicity.

Further, due to the absence of these parts, should occasion demand the ingress of a truck or wagon to unload materials, the mere exertion of bending over to lift the forms off the pedestals is all that is required. The pedestal may be left in place, as the trucks will clear them.

Of course the same advantageous features apply to the Heltzel Standard Rail, made of 10 gauge material, and used where finishing is accomplished by hand. However, but one pedestal is included with each 10-ft. section.

Despite the improvements in the forms, it is interesting to note that contractors in one or two states still desire the forms first mentioned, namely with the angle stake support. Some of these contractors are still using forms purchased five years ago. Others demand the form with the straight pedestal support, and for that reason the company continues the manufacture of all three types.

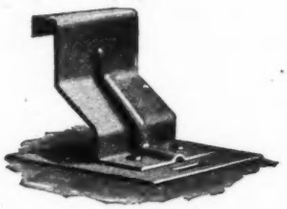


FIG. 5—ILLUSRATES OFFSET PEDESTAL FOR SUPPORTING TYPE H AND TYPE L HELTZEL FORMS, INTRODUCED IN 1920.

The Heltzel Steel Form & Iron Co. also manufacture steel forms for all kinds of concrete work, sidewalks, curbs, curb and gutter, battered curb, integral curb and base, etc. The demand is increasing every year and this firm recently completed an addition to its plant, fully equipped with modern machinery, necessary for perfect workmanship.

Heltzel Forms Used on All World Record Jobs

For the past few weeks, much has been published regarding world records in pouring concrete. The contracting world was startled when articles appeared concerning the Alan J. Parrish record in pouring 744 ft. of 16-ft. road, 8 ins. thick in 9½ hours on June 30, 1920. Later, in fact, on August 6, Mr. Parrish poured 779 ft.

The ink was scarcely dry on this report when Garvey Weyenberg Construction Co., Appleton, Wis., bettered this record by several feet.

Next reports were received from Siems, Helmers & Schaffner of St. Paul, Minn., who poured 1,072.6 ft. of

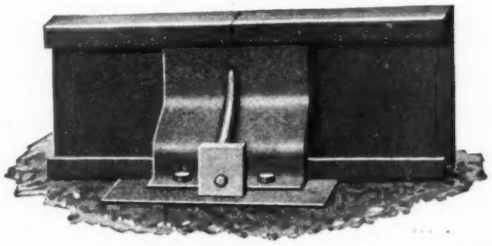


FIG. 6—ILLUSTRATING OFFSET PEDESTAL AND PERFECT JOINTS FORMED BY RAILS BUTTING TOGETHER ON PEDESTAL.

18 ft. road in Rice County, Minn. Later this record was bettered, these contractors pouring 1.074 ft. in 10 hours mixer running time.

But even this concern's record went by the board, when McCree, Moos & Co., St. Paul, Minn., reported a run of 1,094 ft. of 18 ft. road 7 ins. thick in 8 hours; and last reports advise their expectations of raising this record to over 1,200 ft. of finished pavement in 8 hours.

Going back to the year of 1919, we recall that Thomas

E. Currie of Detroit, Mich., put in 10 miles of 24-ft. road in one season—and this was considered a remarkable record.

While different manufacturers' equipment has been mentioned as being used, and while they were factors in making these records, it is worthy of note that Heltzel Steel Road Forms were used on *all* these record jobs.

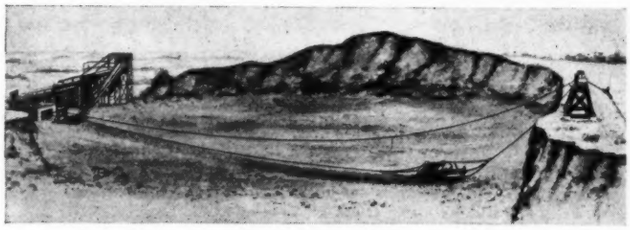
The Heltzel Forms used by Alan J. Parrish were 8-in. Heavy Duty Road Forms, two pedestals being used to a rail. Those used by McCree, Moos & Company were Heltzel Light Forms with the 2-in. narrow flange, and Type L forms with two pedestals per 10-ft. section. Garvey Weyenberg Construction Co. used the Heltzel Light Rail 7 ins. deep by 12 ft. long with a 2-in. flange both top and bottom. Thomas E. Currie used 6-in. Light Forms, same dimensions as given on Garvey Weyenberg Construction Co. forms. Siens, Helmers & Schaffner used the Heltzel light form with the narrow 2 in. flange top and bottom.

Further, on all these record jobs, and naturally on all type forms mentioned, with the exception of the Thos. E. Currie job, several mechanical road finishing machines were used. This fact is worthy of special note, as steel forms must be strong enough to withstand the weight and vibration of these machines. (Note that three differ-

(Continued on Page 32)

A Labor-Saver for Small Gravel Pits

One Man with a Sauerman Bottomless Power Scraper Does the Work of a Large Gang of Men Using Team Scrapers.



CONSERVATIVE claims for the smallest sizes of Sauerman Bottomless Power Scrapers, based on the statements of contractors and county road commissioners who are using them, are that a Sauerman scraper operated by one man will displace from 6 to 15 teams and slip scrapers at a daily saving of $30 to $75. The larger sizes of Sauerman scrapers scrapers are considered by the commercial gravel producers who use them as being the equal of a small steam shovel with the added advantage that they not only dig, but also convey the sand and gravel to the plant.

A Wisconsin sand and gravel producer chose a Sauerman scraper in preference to any other type of equipment when he opened his first gravel pit about six years ago. Today he owns and operates four gravel plants and the excavating and conveying equipment is the same at all—Sauerman Bottomless Power Scrapers.

The many advantages of this one-man operated, combined excavator and conveyor are explained in our Pamphlet No. 10, with illustrations and diagrams of actual installations. Write for YOUR copy of this pamphlet today.

Sauerman Bros., 1142 Monadnock Bldg. **Chicago**

LITTLEFORD
Portable Heating Equipment
FOR CONTRACTORS AND MUNICIPALITIES

Tar Heaters
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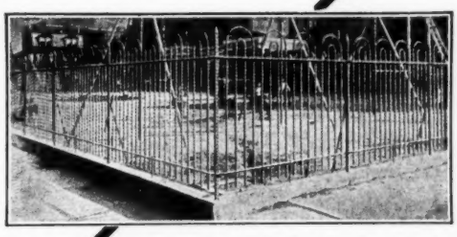
LOADING AND UNLOADING
CARS, TRUCKS AND WAGONS

SAVES 6 TO 12 MEN
SAVES CAR DEMURRAGE

ELIMINATES SHOVEL AND WHEELBARROW WORK
KEEPS EQUIPMENT MOVING

WRITE FOR CATALOGUE

PORTABLE MACHINERY CO., PASSAIC N.J.



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Manufacturers of Ornamental Iron Work, Plain and Ornamental Steel and Iron Fencing, Flower Vases, Settees, Wire and Iron Window Guards, Pipe Railing, Folding Gates, Etc.

REDUCED PRICES

Get in on this drive—buy these meats—reduce the living costs of the people in your community—create a trade compelling attraction. Bring the people into your store—the offering of these guaranteed meats by you will be a wonderful trade stimulator.

LOOK AT THESE PRICES.

Effective November 15th, 1920, Prices on War Department Canned Meats are as Follows:

CORNED BEEF:

No. 1 cans	15c per can
No. 2 cans	27c per can
1 lb. cans	18c can
6 lb. cans	$1.00 per can

CORNED BEEF HASH:

1 lb. cans	15c per can
2 lb. cans	30c per can

ROAST BEEF:

No. 1 cans	9c per can
No. 2 cans	18c per can
1 lb. cans	12c per can
2 lb. cans	24c per can
6 lb. cans	70c per can

BACON:

12 lb. cans	$2.50 per can

SAUSAGE:

Pork, No. 2 cans	25c per can
Vienna, No. 2 cans	25c per can

TABLE OF DISCOUNTS:

The discounts to apply on all purchases of surplus canned meats on and after November 15th, 1920, are as follows:

$250.00 to $1,000	Net
$1,001.00 to $2,500	5%
$2,501.00 to $4,000	10%
$4,001.00 and over	20%

On full carload lots, shipped at government expense, if value of full carload is less than $4,001.00, then 20% discount will be allowed on the value of the carload.

CUMULATIVE PURCHASES COUNT

To stimulate purchases of carload lots and to promote sales in large quantities, further discounts as follows are authorized to customers ordering or re-ordering in carload lots, the value of all purchases of canned meats made on or after November 15th, 1920, only, to be considered in connection with the scale of discounts, as follows:

When purchases reach $50,001	24% net to prevail
When purchases reach $100,001	28% net to prevail
When purchases reach $500,001	32% net to prevail
When purchases reach $1,000,001 and over	35% net to prevail

The foregoing means that the total purchase by a customer in carload lots from time to time will be taken into consideration and the proper discount applied on the sum of all the purchases, including the first carload lot.

Send Orders to Nearest

DEPOT QUARTERMASTER

at the following addresses:

New York City, 461 8th Avenue.
Boston, Mass., Army Supply Base.
Chicago, Ill., 1819 West 39th Street.
Atlanta, Ga., Transportation Bldg.
San Antonio, Texas.
San Francisco, Calif.

War Department Canned Meats

Buy $250.00 worth or a carload or a trainload—the more you buy the cheaper it is, and remember it is the total of all your purchases that counts in figuring up your discounts. Order—Sell—and Re-order. Then do it all over again.

ORDER—SELL—AND RE-ORDER.

CREDIT SALES:

Depot Quartermasters are authorized to sell surplus canned meats for cash, bankers' acceptance, or on not to exceed ninety (90) days straight credit in the commercial sense.

Credit will be extended only to those individuals, firms or charitable organizations which can establish a satisfactory credit rating (Dun's, Bradstreet's or Banks), or to Municipalities having a bona fide purchasing organization. The credit risk in each case is left to the decision of the Depot Quartermaster.

FREIGHT PREPAID

Shipments of not less than carload lots will be made at government expense to any point in the United States outside a radius of 20 miles of the point of storage from which shipment is made.

The government will not be liable for any demurrage or switching charges that may accrue after goods are loaded for shipment. Prices quoted are in all cases f. o. b. storage point, with freight prepaid, as above specified on carload lots.

SAMPLES ON REQUEST:

Depot Quartermaster in your district will, on receipt of price of samples wanted and postage costs, be glad to send same to prospective purchasers in their respective zones.

GUARANTEED CONDITION

The government guarantees to deliver all meats in perfect condition. The most rigid inspection will be made of each shipment before it leaves point of storage, thus insuring full protection to all purchasers.

ORDER NOW

We respectfully suggest that immediate steps be taken by interested parties to familiarize themselves not only with the superior quality of these canned meats, but that they compare the prices herein quoted with prices for the same commodities from other sources so that they may fully realize the immensity of value to be obtained by participating in the distribution of these goods.

SURPLUS PROPERTY BRANCH

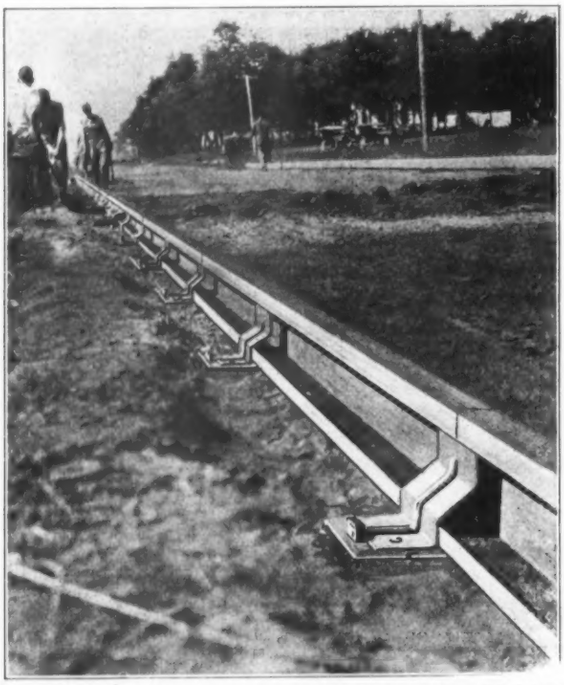
OFFICE OF THE QUARTERMASTER GENERAL

Munitions Building. **Washington, D. C.**

(Continued from page 29.)

ent type Heltzel forms were used under these machines).

The accompanying views illustrate the forms as used by various contractors, and show the improvements made by the Heltzel Company. As a matter of fact, very few changes have been made in Heltzel forms. This company was the first to realize the importance of having a broad bearing surface on the lower flange of the forms, bringing out the Heavy Duty Form the first of 1920.



ILLUSTRATING PERFECT ALIGNMENT SECURED WITH HELTZEL STEEL ROAD FORMS.

This form met with instantaneous approval of contractors, as is evidenced by repeat orders from all sections of the United States. The extreme simplicity of the forms permits rapid set-up, a feature which appeals to contractors. The forms are quickly lined up and set—and stripping from the finished work is child's play.

THE NEW MERRIMAN ASPHALT PLANT SHOWS MANY IMPROVEMENTS

The East Iron & Machine Company, Lima, Ohio, who have been building the Merriman One-Car Steam-Melting Asphalt Plants since 1905, announce that the Improved Merriman No. 3 is now on the market, and several have already been sold. This plant possesses many features which add efficiency and make it easier to transport and handle.

The new plant is only 58 ft. over all and is the shortest complete railroad plant of its capacity on the market. With all this, the guaranteed capacity is 2,000 sq. yds. of 2-in. topping, or 2,800 yds. of asphaltic concrete in a 10-hour day. Users of this plant are now laying over 3,000 yds. of 2-in. topping in a 10-hour day.

The side sills are extra heavy girder construction. They are so constructed that they cannot sag or warp out of shape. The trucks are extra heavy, M. C. B. standard, with 6x11-in. journals, special hammered steel axles and chilled wheels. The arch bars are made of bar steel. The boiler is of the locomotive type, specially built, and of 125 h.p., with a capacity of 160 lbs. pressure. It is constructed under the State of Ohio and A. S. M. E. Specifications, and will pass the Inspection Bureau of every state. It is extra heavy and specially designed, so that it is a good steamer and very easy to clean. The power equipment is specially designed. The engines are of simplified construction, very heavy, and all parts are readily accessible.

Four melting kettles are used, and to insure compactness and solidity they are constructed in one unit. Each kettle is equipped with two steam coils, made of heavy electrically welded pipe. These kettles are so arranged that air pressure can be used to facilitate discharge of the asphalt, and so that either air or steam can be used for agitation. Clean-out doors are placed at close intervals.

The sand drum is of a special type of construction, and is patented. It is 5 ft. in diameter and 25 ft. long. No internal spiders are used, and four heavy I-beams act as spill plates and carry the sand so that it falls through the heat as the drum revolves. Spiral flights carry the material forward. The drive end of the drum runs on special trunnions and a special riding ring, and is driven by means of gear segments around the outside of the drum. The capacity is greater than the material required for the rest of the units of the plant, and is approximately 25 tons per hour.

The mixer has a capacity of 12 cu. ft. and is equipped with special patented blades, having renewable ends. This mixer is so arranged that the material can be dumped directly into motor trucks which run under the mixer platform.

The hot material storage bin is telescopic and holds 12 cu. yds., or 15 tons, so even with this extra large capacity the bin can be easily closed down on platform without removing any parts.

The working platform, on which the mixer, etc., is located, is a patented arrangement. When extended for operation it permits trucks and wagons to pass under the mixer dump. When packing the plant for shipment it is easily drawn within shipping length of the car, and clears the end of the car frame.

Elevators on both sides of the plant feed the sand drum, so material can be stored on either or both sides. The hot material elevator is entirely enclosed in dust-tight sheet-steel housing, made in sections, which can easily be removed to facilitate packing for shipment.

The fire box is arranged for burning coal, coke, wood or fuel oil. It gives a choice of fuel at all times and saves a lot of trouble. Many other improvements that greatly increase the efficiency of the plant have been made, and the Improved Merriman is attracting considerable attention from the larger contractors.

WORKING ON THE SUB-GRADE PROBLEM

Why highways fail was taken up by engineers, highway officials and scientific men in leading universities at a meeting of the sub-grade committee of the Federal Highway Council, held at Wilmington, Del., Nov. 22

and 23, 1920, under the chairmanship of Gen. T. Coleman DuPont of New York.

Among the scientific men attending were Prof. Hector J. Hughes, Dean Harvard Engineering School; A. T. Goldbeck, testing engineer, U. S. Bureau of Public Roads; Prof. F. H. Eno, chair of engineering, Ohio State University; H. E. Hilts, of the Pennsylvania State Highway Department; H. G. Shirley, of the Federal Highway Council, and Ira B. Mullis, Bureau of Public Roads, Washington, D. C.

Reports were made by problem committees working under a main committee. During the discussion which followed the presentation of these reports the statement was made by W. P. Blair of Cleveland, Ohio, that 20,000,000 people had been added to the population of the United States, practically without one inch being added to the transportation facilities of the country, and that on top of this increased population was an increased tonnage, due to greater buying by the people, equal to another 20,000,000, making a total of practically 40,000,000, in the face of inadequate transportation. The result of this increased tonnage, it was asserted, had been to break down roads, through no fault of construction, but because traffic growth had not been taken into full account.

The development of railway engineering was used as an example to show why heavier type highways must be built since the same law of tonnage growth applies to both the railway and the highway. In the case of railway, Mr. Blair asserted, the laying of heavier rails, enlarging tunnels and reducing grades, has been going on constantly during the past 30 or 40 years, and yet the highway, without a comparative development, had been called upon within the last ten years to sustain a traffic growth unequalled in any like period in the history of the country. The situation this created, it was pointed out, called for a determined effort to build better road foundation in order that breaks in the surface may be eliminated.

Gen. DuPont followed Mr. Blair with the statement that the problem of the subgrade, or road foundation, was the most important duty before highway engineers and officials today. It was his belief, as a result of experience in highway development, that the foundation problem must be solved, and solved speedily, otherwise the movement to round out a complete system of county, state and interstate highway transportation will be retarded, to the great detriment of the American public.

C. M. Upham, State Highway Engineer of Delaware, explained how his department was making field tests to determine the bearing power of various kinds of soil and what methods to pursue in order to increase that sustaining power and thus prevent the breaking down of the road surface.

On the point of road failures, Mr. Shirley, former state highway engineer of Maryland, called attention to the fact that roads are sometimes charged with having failed, despite the fact that in actual service they may have saved their cost many times over before reaching the point where reconstruction becomes necessary. He hoped, he said, that the public would take this fact into account in their future discussions relating to road building.

S. M. Williams, chairman of the Federal Highway Council, addressed the committee briefly upon the importance of conducting the subgrade research work as rapidly as possible in order that road building upon a greater scale than ever before may go forward without wasteful expenditure of funds upon roads that soon prove unequal to the burden thrust upon them, through a lack of proper understanding of the soil upon which the subgrade rests.

Investigations in widely separated sections of the United States are to be conducted simultaneously and reports made at subsequent meetings of the subgrade committee. The work is under the direction of the Federal Highway Council, which hopes through the movement now undertaken to save millions of dollars to the public in the future in the construction of roads that will not fail.

CONTRACTS AWARDED

ROADS AND STREETS

Ala., Montgomery — L. C. Rawlinson, Montgomery, awarded contract for grading, draining and surfacing 5.44 miles State Trunk Rd., from Girard to Tuskegee, Russell Co., sand-clay, at $38,936; 12.053 miles Chisholm Rd., Florence to Tennessee state line, Lauderdale Co., chert and gravel, to W. T. Taylor Constr. Co., Wilsonville, at $156,885.

Ariz., Tombstone—Dan LaRoe, Palestine, awarded contract for construction of Sec. 2, Douglas-Rodeo Hwy., about 23 miles, to be surfaced with gravel or caliche base, to be 22 ft. wide and top 16 ft., etc., at $130,467.

Ark., Little Rock—Contracts for surfacing Spring Lake Hwy., to cost $983,339, awarded as follows: M. D. L. Cook, surfacing from city limits to Granite Mountain, 5 miles; Oliver Constr. Co., work from Granite Mountain to county line, 20 miles. Approx. $174,279 and $908,060, respectively. The 5-mile section is to be constructed of Warrenite on stone bases and the 20-mile stretch of asphalt concrete on concrete base.

Cal., Bakersfield—Rogers Bros. Co., 350 Merrick street, Los Angeles, awarded contract for reconstructing and widening 13.745 miles Bakersfield-Taft Hwy., at $359,000.

Cal., Los Angeles—Fred Hoffman, 111 E. Twelfth street, Long Beach, awarded contract for paving Hawthorne avenue, Arbor Vitae street at Inglewood, city limits, to the Los Angeles-Redondo Rd., 5.38 miles; 5-in. concrete pavement reinforced with wire mesh 20 ft. wide. Entire length, 28,140 ft., of which 14,031 will have 5-in. disintegrated granite base. Contract price, $224,000.

Cal., San Anselmo—A. J. Raisch, 46 Kearney street, San Francisco, awarded contract for paving Red Hill and Ross Landing Rd.; also San Rafael and Olema Rd., Marion Co., with 6-in. concrete base and 1½-in. asphalt concrete surface, at $99,563.

Cal., Susanville—Warren Bros., Boston, Mass., awarded contract for paving streets and constructing cement walks here, at $191,256.

Cal., Visalia—Rebell Constr. Co., Fresno, awarded contract for grading and paving with concrete Yettem-Elderwood Co. Hwy., about 10 miles, county to furnish materials, at $121,238.

Ga., Blackshear—Brooks-Calloway Co., Healy Bldg., Atlanta, Ga., awarded contract to construct 8.93 miles sand-clay road, building reinforced concrete bride, etc., at $82 000.

Ia., Ames—**Ira Cox**, Sioux Falls, S. D., awarded contract for 23 miles graveling, at $70,000.

Ia., Carroll—Peterson, Shirley & Gunther, 1217 W. O. W. Bldg., Omaha, Neb., awarded contract for grading 19 miles Coon Rapids-Dedham-Templeton-Manning Rd., at $125,266.

Ia., Vinton—Moore-Young Constr. Co., Waterloo, awarded contract for paving 9 miles of county road, at $420,971.

Kans., Wichita—Ritchie Bros. and C. B. Ramsey, Wichita, awarded contracts for paving various streets here, at about $150,000.

Ky., Harlan—Geo. M. Eady Co., Louisville, Ky., awarded contract to construct 4-mile road; Kentucky rock asphalt, at $99,752.

La., New Orleans—City let contract for improving (1) Broad street, Canal to New Basin Canal; (2) portion of Sycamore; (3) S. Claiborne avenue; (4) Broad street; (5 S. Claiborne; (6) Magazine street; (7) Calliope street; (8) Julia street, (a) paving, (b) subsurf. drains to Craven & Lang, 1015 Hibernia Bank Bldg.; (1a) $165,953, (2a) $3,601; (3a) $171,468; (4a) $101,696; (5a) $200,821; (6a) $277,971; (7a) $34,920; (8a) $23,529; M. Mitchell, 2646 Banks street, (1b) $69,830, (3b) $94,473; C. W. Kreher, 300 S. Clarke street, (2b) $5,214, (7b) $11,641; E. Egans Sons, 4338 Canal street, (4b) $111,704, (6b) $181,644, (8b) $24,098; Crescent Contg. Co., Inc., (5b) $283,755.

Me., Augusta—Greenwood Constr. Co., Skowhegan, awarded contract for paving state highway, gravel, Littleton, at $117,987.

Mass., Brighton—Simpson Bros., Corp., awarded contract for new smooth pavement in Market street, Brighton-Washington street across Western avenue, and in Arlington street, Brighton from Market street across Leicester street, at $97,742.

Mich., Lansing—M. C. Hull, Dryden, awarded contract for road 21-12, C-D, St. Clair Co., for grading and draining struc-

tures at 7.592 miles, at $38,154; Herbert Campbell & Son, Port Huron, awarded contract for road 21-13, E-F, St. Clair, grading and draining structures, 6,056 miles, at $34,-953; Cook & Clark, Grand Rapids, contract for road No. 85-1, Montcalm, for B gravel, 6,145 miles at $74,971.

Mich., Lansing—State Hwy. Dept., Lansing, let contract for grading, draining and surfacing 1.582 miles State Trunk Line Rd., 10-19, 20 ft. wide, to Board Rd. Commrs., Wayne Co., Detroit, at $115,563.

Minn., Hibbing—General Contg. Co., Minneapolis, awarded contract for 21,000 sq. yds. Warrenite-Bitu. pavement.

Minn., Minneapolis—City will expend $1,-000,000 for various kinds of paving. Work will be done by day labor under supervision of E. R. Dutton, Asst. City Engineer.

Minn., Shakopee—John Cox, 567 Gilfillan Bldg., St. Paul, awarded contract for F. A. P. 93, St. Rd. 9, at $102,448; 7 miles long.

Minn., Walker—Latvala, Lidberg & Lake awarded contract for construction of 15-mile road from Pike Bay, on east side of Cass Lake, to Bena, at $145,000.

Neb., Omaha—Peterson, Shirley & Gunther awarded contract for building 4.257 miles Lake Andes-Platte-Chamberlain Rd., F. A. Proj. 68, at $30,318; W. P. Shipman Constr. Co., 209 Iowa Bldg., Sioux City, awarded contract for gravel surfacing 16.7 miles Parker-Centerville Rd., Parker to Viborg, at $98,749.

N. Y., Brooklyn—Sicilian Asph. Paving Co., 47 Park Row, New York City, awarded contract for regulating and repaving Linder street, at $21,41; 72nd street, 3rd to 6th avenues, to Brooklyn Alcatraz Asph. Co., 409 Hamilton avenue, at $108,265.

N. Y., New York—H. H. Curran, president Manhattan Boro, let contracts for regulating and repaving Lexington avenue and 125th street, First to Second avenues, to W. J. Fitzgerald, 150 Nassau street, at $62,164 and $49,630, respectively; 125th street, Second to Third avenues, and Lexington avenue, to P. J. Kearns, 2306 Creston avenue, at $41,727 and $9,974, respectively; Washington street, to O'Rourke Constr. Co., at $218,413; E. 24th street, to Burnside Contg. Co., 270 Burnside avenue, at $29,085.

N. Y., Poughkeepsie—Rosoff Engrg. Co., Inc., Park Row Bldg., N. Y. City, awarded contract for constructing road 1396, Nassau Co.; road 5588-B, Green Co. Rd.; 1535, Rockland Co., total of 0.59 miles concrete, at $30,743, and road 5649, Rockland Co., 0.50 miles, concrete, at $43,817; R. W. S. Corp., 30 Church street, N. Y. City, low bidder for road 1208, Suffolk Co., 4½ miles concrete pavement, and completing trimming shoulders and cleaning, 0.57 miles, at $179,955.

N. Y., St. George, S. I.—C. Vanderbilt, Elizabeth street, W. New Brighton, awarded contract for repaving Richmond Turnpike, concrete, at $108,940.

N. C., Burgaw—Potter & Boyd, Charlotte, N. C., awarded contract to construct 27 miles Wilmington-Goldsboro Rd., gravel, concrete brdgs., etc., at $235,000.

N. C., Charlotte—Simmons Constr. Co., Charlotte, awarded contract for improvement of 4.59 miles of road between point 1 mile north of Matthews and Mecklenburg counties, at about $170,000.

N. C., Greensboro—St. Hwy. Comn., Div. Office, let contract for improving 9.64 miles F. A. Proj. 101B, 18 ft. wide, Randolph Co., and 21.82 mile road between Pittsboro and Chatham-Randolph counties, line 18 ft. wide, Chatham Co., to J. T. Plott, Greensboro, at $62,500 and $125,370, respectively; 5-mile road from Sparta to Clade Creek, F. A. Proj. 125A, 12 ft. wide, Alleghany Co., to W. L. Graham, Mt. Ulla, at $139,-510; 11.93 mile road from Virginia state line to Yanceyville, F. A. Proj. 112, 18 ft. wide, Caswell Co., to J. M. Gregory & Co., Laurens, S. C., at $63,300.

N. C., High Point—R. G. Lassiter, Norfolk, Va., awarded contract for 7,000 sq. yds. Warrenite-Bitu. pavement on 5-in. concrete foundation; also contract for 21,-000 sq. yds. Warrenite-Bitu. pavement on 5-in. concrete foundation, in Guilford Co.

N. C., Nashville—R. G. Lassiter Co., Raleigh, awarded contract to construct 25,000 sq. yds. streets, at about $125,000.

N. C., Newton—G. R. Martin, N. Kerr street, Salisbury, awarded contract for grading, draining and paving Main, College et al. streets, involving 25,000 sq. yds. concrete paving, at $2.70 per sq. yd., 26,400 lin. ft. concrete walk, at $1.75, 31,600 lin. ft. comb. concrete curb and gutter, at $1.25, etc., total about $100,000.

N. C., Pittsboro—J. T. Plott, Greensboro, awarded contract to construct 21.82 miles topsoil, gravel or artificial sand, clay surfacing road, Proj. 99-B, at $125,590.

N. C., Sparta—W. E. Graham, Mount Ulla, N. C., awarded contract to construct 5 miles roadway, waterbound macadam, bridges, Proj. 125, at $102,780.

Ohio, Portsmouth—S. Monroe & Sons, Portsmouth, awarded contract for grading, building bridges and culverts and paving 1.99 miles Sec. B, Portsmouth-Oak Hill Rd., monolithic brk., $96,861; 1.794 miles Sec. A-3, Portsmouth-Jackson Rd., monolithic brk., at $94,894; A. E. Simpson, Portsmouth; 2.998 miles Sec. B-1, Portsmouth-Lucasville Rd., waterbound gravel, $48,994.

Pa., Harrisburg—State Hwy. Dept. let contract for repaving Route 68, Indiana Co., to McCrady Bros., Sixth street, Braddock, at $248,648; Route 11, Luzerben Co., to H. B. Sproul Constr. Co., Inc., 218 Adams avenue, Scranton, at $109,467; Route 176, Lycoming Co., to R. J. DeLong, 229 W. Fourth street, Wilmington, at $44,696; Route 181, North and South Strabane Twp., Washington Co., to Burgess & Dorrier, Scottsville, Ga., at $31,495.

Pa., Harrisburg—J. B. Reed Co., McKees Rocks, awarded contract for 4,375 ft. road between Rochester and Freedom, at $77,-211; 3,641 ft. in Economy Twp., at $59,-849; S. B. Markley, New Brighton, contract for 11,097 ft., Rochester, at $149,322.

Pa., Philadelphia—Barber Asph. Paving Co. awarded contract for paving Seventy-third street, Elmwood to Gray's avenue, at $13,150; Twentieth street, Church Lane to Godfrey avenue, at $24,050, and Sixtieth street, Jefferson to Lancaster, at $24,350.

Pa., Philadelphia—Union Paving Co. awarded contract for street repairs, at $250,000.

Pa., Pittsburgh—M. O'Herron & Co., S. First and McKean streets, awarded contract for grading and paving Carson street, Smithfield to Seventh streets, at $104,886.

Pa., Tullytown—B. Foster Co., Pittsburgh, awarded contract for building 7,180 ft. Main street, concrete, part of Penn. State Hwy., at $117,371.

S. C., Charleston—Commrs. Charleston County will construct 7-mile Mary and Johns Island Rd.; concrete. About $400,-000. Work by day labor. J. W. Martin, Charleston, Engr.

S. C., Columbia—Slattery & Henry, Greenville, awarded contract for building 2-mile road from Greenville to Jones Store, north of here; concrete, at about $113,000.

Tex., Cleburne—F. S. Harris Constr. Co., Ft. Worth, Tex., awarded contract to construct 20 miles Cleburne and Dallas Rd. and 8 miles Godlet and Cresson Rd., at $211,918.

Tex., Franklin—Harris & Powell, Tyler, awarded contract for grading, surfacing and building concrete and steel bridges and concrete culverts on 17.99 miles Highway 14, Nesbit, to 2 miles north of Wheelock, 15 ft. wide, at $204,136, including 10 percent for engineering and contingencies.

Tex., Jourdanton—W. T. Montgomery, Alamo Bank Bldg., SanAntonio, awarded contract for grading, surfacing and draining 13.47 miles Hwy. 9, from Pleasanton to Bexar Co., 16 ft. wide, at $187,639, including 10 percent for engineering and contingencies; also freight charges on gravel.

Tex., Mt. Pleasant—Wilder & O'Neal awarded contract for construction of 20.2 miles Highway No. 35, at $209,321.

SEWERAGE AND SEWAGE TREATMENT

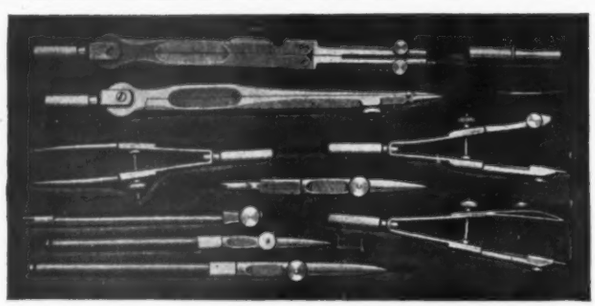
Ariz., Yuma—C. Fisher, 328 Willetta street, Phoenix, awarded contract for building sewerage system in District 3, involving 39,820 ft. 4-20 in. vitr. clay pipe, 8 flush tanks, 52 manholes, 16x16 ft. concrete pump house and pumping unit complete, at $139,461.

Cal., Fullerton—W. Ledbetter, P. E. Bldg., Los Angeles, awarded contract for building sludge tank, screening plant, pipe lines and channels, at $17,374.

Cal., Yuma—Gordon Const. Co., Century Bldg., Denver, awarded contract for building sanitary sewerage system, including septic tank, with necessary manholes, etc., at about $60,000.

Ill., Chicago—T. J. Forschner Contg. Co., 125th street and Michigan avenue, city, awarded contract for construction of sewage treatment plant, by San. Dist. of Chicago, at $4,900,527; American Sewer & Drain Constr. Co., 2816 N. Washtenaw avenue, awarded contract for sewage conduits, at $588,227.

Ind., New Castle—Charles W. Minnick awarded contract for installation of sewer on E. Plum street, with a number of branches and intersecting streets, at $14,-



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607. Sewer will be built during winter months.

Ind., Princeton—Geo. A. Harrop, South Bend, awarded contract for sewerage work at Princeton City, at $58,800.

Ia., Gilmore City—Rude & Wold, Pomeroy, awarded contract for building sewerage system, at $85,099; disposal plant to Phelps & Sons, Knoxville, at $27,309.

Kans., Wichita—H. L. Miles, 809 Beacon Bldg., awarded contract for building storm sewer No. 19, involving 2,300 ft. 30-36-in. segment block brick, 13,300 ft. 10-27-in. vitr. pipe, etc., at $56,518.

Ky., Louisville—K. A. Barker, Henry Bickel Co., and L. R. Figg awarded contracts for sewer construction; 36 to 12-in. vitr. pipe and segment tile, at total cost of $70,000.

Mich., Detroit—City let contracts to V. Teetaert, 5230 Notre Dame street, for furnishing labor and material for building and backfilling 10-24-in. vitr. crock lateral sewer 3310, between 7-Mile Rd., Livernois, Canterbury and Pembroke streets, at $136,630; 3334, at $14,920; 3367, at $42,266; W. Blanck & Co., 827 Ford Bldg., 3314, at $35,719; 3316, $64,382; 3366, $20,938; S. A. Duponovich, 3333, at $13,100; Otis Cement Constr. Co. 806 Hammond Bldg., 3337, at $25,146; 3339, at $14,980; 3341, at $15,936; 3354, at $24,591; 3355, at $16,996; McCordic Constr. Co., 400 Penobscot Bldg., 3360, at $7,775; 3361, at $4,833; 3362, at $13,306; 3363, at $23,688; 3364, at $13,031; 3365, at $3,828; Langley & Barton, 3369, at $62,683; Western Constr. Co.., 1208 Ford Bldg., 3378, at $10,842.

Mich., Lansing—E. J. Noyce, Lansing, awarded contract for labor for building sanitary sewers in district north of Potter Pk., at about $40,000, tile, blks. and castings to be furnished by city.

Mich., Pontiac—Foley-Riley Co., Chicago, awarded contracts for two sections of city's main sewer, both of which are tunnel jobs, through heart of business section. Sec. No. 2 will cost $108,701; Sec. No. 3, $94,188.

Minn., Milaca—Milaca Bridge Co., Milaca, awarded contract for building sewerage system, at about $22,500.

Minn., Minneapolis — Sauger-Karsmolo, St. Paul, Minn., awarded contract for construction of sewer, at $215,000.

Miss., Meridian—Myers Constr. Co., Hattiesburg, Miss., awarded contract to construct storm and sanitary sewers on Twenty-fourth avenue, at $20,200. John C. Watts, Engr., Meridian.

Mont., Butte—Maurice Kiley awarded contract for construction of sanitary sewers in Northwest District, at $21,745.

Neb., University Pl.—Dobson Co., 809 First National, Lincoln, awarded contract for sewer work, at $46,000.

N. Y., Middletown—Thos. E. O'Brien, Inc., Brooklyn, awarded contract for sanitary works, underground sewer connections for Chronic Hosp., State Homeo Hosp., Middletown, at $25,700.

N. Y., Syracuse—John Young awarded contract for extension of main intercepting sewer, at about $258,500.56. Contract provides for construction of 9-ft. sewer from Spencer street, where present sewer empties into Onondaga Creek to 300 ft. north of Hiawatha avenue.

N. D., Hankinson—J. O'Connor Co., Fargo, awarded contract for building sewerage system, involving 26,709 ft. 8-15 in. vitr. pipe, 48 manholes, 1 septic tank and 1 sludge bed, at about $82,000.

Ohio, Akron—T. E. McShaffrey Const. Co. awarded contract to build sewers, drains and inlets in S. Maple street, W. Market to W. Exchange streets, segmental block, at $59,426.

Ohio. Hamilton—The John L. Walker Co., Hamilton, O., awarded contract for construction of sanitary sewers and house connections, at $25,871; John H. Trunck & Sons, 943 Greenwood avenue, Hamilton, awarded contract for construction of sanitary sewers and house connections, at $22,236.

Ohio, Yorkville—E. C. Baker, Uniontown, Pa., awarded contract for building 5-mile sewer in 3 sewer districts, involving 72 manholes, 21,000 cu. yds. earth trenching, at $64,484.

Okla., Miami—James & Shoe, Miami, awarded contract for sewage disp. plant and sewer mains, at $142,101.

Pa., Philadelphia—City let contracts for building sewers in B street, Rosehill to Erie street and in Somerdale, Adams to Frankford branch of Penn. R. R., to J. Perna, Sixty-fifth and Callowhill streets, at $100,000 and $50,000, respectively; in portions of Bingham street to R. Lombardi, Seventh and Christian streets, at $63,000; Ditman street, to Curtis Bros., League Island, at $75,000; Godfrey avenue, to E. Pasouzzi, Lincoln Bldg., at $32,000; Ninth street, estate of D. McMahon, Germantown and Chelton streets, at $93,000; building inlets, to F. T. Buckius, Jr., Kensington and Deal streets, at $25,000.

Tex., Dallas—Klein Bros. awarded contract for installing sanitary sewers in Park View Addn., at $38,772; Blackmear & Post Pipe Co., contract for pipe, at $18,861.

Tex., San Antonio—Campbell & Hengst Constr. Co., San Antonio, awarded contract for construction of sewers in East End District, at $45,000.

Tex., Wichita Falls—James Constr. Co., Dallas, awarded contract for building sewage disp. plant at North West Texas Insane Asylum, at $47,700.

Utah, Delta — C. Thompson, Delta, awarded contract for building sewers in various streets, at $100,519.

Utah, Salt Lake City—R. E. Campbell, 801 Newhouse Bldg., Salt Lake City, awarded contract for sewer extensions, at $203,444.

Wash., Seattle—Fiorito Bros. awarded contract for clay pipe sewers in Hinds street, at $46,095.

Wash., Wapato—G. M. Savage (Savage Constr. Co.) will probably be awarded contract for constructing sewer system, at total cost of about $70,000.

Wash., Yakima—H. Hardy awarded contract for construction of 2½ miles of sewer, at $99,926.

W. Va., Charleston—T. B. Roberts awarded contracts for sewers on Carr street, at $15,586; on Garvin avenue, $9,091; Beachwood avenue, $5,647; Hansford street, $9,079; Piedmont Rd., $3,107; Brown & Floyd, contract for sewer in alley east of Tenn., at $1,751.

Wis., Cedarburg—Brogan & Burns, Green Bay, awarded contract for building new sewerage and water works system, at about $83,000.

Wis., Manitowoc—W. O. Bahn, Eighth street, awarded contract for building 6-10 in. vitr. sanitary storm sewer in Western tract for remodeling sewage disp. plant Majestic Bldg., Milwaukee, awarded con-

Wis., Wauwatosa—Kroening Constr. Co., avenue and Clark square, at about $21,000. here, at $27,252.

Wis., W. Bend—Cornillissen & Co., 73 Lincoln street, Sheboygan, awarded contract for labor and material for building sanitary sewerage system and excavating and laying water mains in Main and Elm streets, at about $20,000.

WATER SUPPLY AND PURIFICATION

Ariz., Tucson—Littlejohn & Singleton, Tucson, awarded contract for construction of 1,500,000-gal. reinf. concrete reservoir for municipal water system, at $36,400.

Cal., Sacramento—City Comn. has recommended that contract for construction of new filtration plant be awarded the Coast Constr. Co., Crocker Bldg., San Francisco, subject to approval by city attorney. Work will include reinf. concrete buildings, bridge, pipe line, etc. Estimated cost, about $1,047,005.

Cal., Sacramento—Latourette Fical Co. awarded contract for two motors and extra parts, at $12,165; Lawrence & Co. awarded contract for $8,102 for high-pressure centrif. pump.

Conn., Bridgeport—Bridgeport Constr. Co., 983 Broad street, awarded contract for building Black Rock pumping station, one story, 25x30 ft., concrete, brk. and steel, at $32,000; Island Brook pumping station, on Berkshire Pond, one story, concrete, brk. and steel, at $30,000.

Ind., E. Chicago—Jas. J. Laughlli Co., 4724 Forsythe avenue, E. Chicago, awarded contract for furnishing and installing 19,000 ft. pipe ¾-in. to 6-in., including valves, fittings, etc., at 18,556.

Ia., Atlantic—R. O. Lovett, Atlantic, awarded contract for building rein. concrete reservoir, 250,000-gal. capy., at about $12,000.

Ia., Wapello—Layton Constr. Co., Muscatine, awarded contract for 2 pumping plants at Drainage District 22, 2 miles southwest of Oakville; also Drainage District 23, 2½ miles southwest of Conesville, at $90,000.

Kans., Portis—C. H. Everett, Hutchison, awarded contract for building water works system, including water tower, distributing system, etc., at $25,590.

Mass., Boston—Worthington Pump & Machinery Corp., 206 Devonshire street, awarded contract for building pumping engine at Chestnut Hill Pumping Station, Brookline, at about $75,900.

Mass., Boston—T. Russo, 72 Pinehurst street, Roslindale, awarded contract for laying cast iron water pipes and appurts. on Battery and Atlantic streets, at about $15,000.

Mass., Boston—D. Vitiello awarded contract for laying and relaying water pipe in Ashland street, Florence, Poplar and Wachusett streets. West Roxbury, at $9,007; John Williams awarded contract for laying and relaying pipes in Washington, Groton, Laconia and Acton streets, Boston, at $5,420.

Mich., Ecorse—Lester J. Clancy, Detroit, awarded contract to construct extension to water system, at $67,000.

Minn., Cloquet—Pastoret Constr. Co., 308 Snellwood Bldg., Duluth, awarded contract for building water mains and sewers in H avenue and Laurel street, at $12,554.

Minn., Duluth—Nelson & Hafner, 904 E. Third street, awarded contract for water and gas mains in Oxford street, at $14,366; Hersey Mfg. Co., contract for two 3-in. Hersey water moters and two 2-in. Hersey water meters, at $39; John Hedberg, 2208 W. Second street, awarded contract for water and gas mains in Second avenue W., from mains in Seventh street to Eighth and in Eighth street from 250 ft. east of Second avenue W. westerly to boulevard, at $7,368.

Minn., Wells—O. H. Olson & Co., Stillwater, awarded contract for building water works system, at $15,225.

N. D., Hankinson—W. D. Iovell, 1415 S. E. Eighth street, Minneapolis, Minn., awarded contract for building water works system, involving 25,980 ft. 4-8 in. cast iron pipe, 30 hydrants, one 100,000-gal. tank and tower, etc., at about $151,000.

Ohio, Dayton—C. J. Betzel, 146 Washington street, awarded contract for furnishing and laying 30,000 ft. 4-18 in. cast iron water mains in Mt. Auburn District, at $195,031.

Wash., Bremerton—City let contract to F. N. Badolato, Builders' Exch., Seattle, for installing water mains, hydrants, valves, gates, etc., involving 20,000 ft. 6-in. wood pipe and 1,700 ft. c. I. pipe, at $53,505.

PROSPECTIVE WORK

ROADS AND STREETS

Ala., Decatur—Morgan County has voted $440,000 bonds to build state and Federal roads.

Ariz., Tucson—Survey for direct road from Tucson to Gulf of California is now being made by Pima Co. Hwy. Comn. County will construct 48 miles road from Robles ranch to border, for which $110,000 is available from bond issue. Residents of Altar District, in Mexico, have given assurance that funds will be provided to construct portion of road below border as soon as Pima County section is completed.

Ark., Lake Village—$250,000 bonds sold for construction of Dermott-Collins Road, by Chicot Co., Commrs., Lake Village, Ark., and Drew Co., Commrs., Monticello.

Cal., Bakersfield—Paul E. Kressly, Cons. Engr., Los Angeles and Newport Beach, has been appointed by supervisors Kern County engineer for road. First improvement, No. 10, to widen and resurface with concrete 3 miles of present paved highway from Bakersfield to Oildale, and to construct 4 miles concrete pavement 18 ft. wide and 6 in. thick from Oildale over Bniaa grade to E. Bakersfield, including two reinf. concrete bridges over Kern River.

Cal., Pomona—Resolution adopted to pave alleys in 10 city blocks with 5-in. concrete with ¾-in. oil and rock screenings surf.

Cal., San Fernando—Resolutions adopted for following street work to be done under Vrooman Act: Maclay avenue, Fifth to Sixth streets, to be graded and paved with concrete; Fourth street, Hagar to Jessie streets, and Griswold avenue, Third to Fourth streets, to be graded, oiled and macadamized, etc.

Colo., Manitou—City will soon undertake paving project which will cost between $70,000 and $90,000. In response to petition from more than one-half the residents on Manitou avenue thoroughfare will be paved from Huxton avenue to Denver & Rio G. depot. The paving will extend little less than a mile through heart of city. In addition to the paving curbs, gutters and sewers will be laid prior to construction of paving. In addition, Manitou Bd. has appropriated $10,000, which it will pay as city's share to State Hwy. Comn. if commission will contract for additional mile of paving west from present connecting link of pavement between Colorado Springs and Manitou.

D. C., Washington—Secy. of Agricul. approved Ohio road building project which

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Harris Air Pump Co.

Armor Plates.
Truscon Steel Co.

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Uvalde Asphalt Paving Co.
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Barber Asphalt Paving Co.
The Barrett Co.
Bitoslag Paving Co.
Sinclair Refining Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
Barber Asphalt Paving Co.
The Barrett Co.
Sinclair Refining Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The

Asphalt Plants.
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Son Co., F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Asphalt Railroad Plants.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Asphalt Surface Heaters.
Barber Asphalt Paving Co.

Asphalt Tools.
Barber Asphalt Paving Co.
Warren Bros. Co.

Asphalt Tool Wagons.
Barber Asphalt Paving Co.

Auto Fire Apparatus.
Acme Motor Truck Co.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Co., The
Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling and Harnischfeger.

Barber Brand Cold Repair Cement.
Barber Asphalt Paving Co.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Bermudez Road Asphalt.
Barber Asphalt Paving Co.

Binders, Road.
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros. Co.

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Columbian Steel Tank Co.

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Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling and Harnischfeger.

Buckets, Dumping.
Pawling and Harnischfeger.

Buckets, Grab.
Mead-Morrison Mfg. Co.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Pullers, Electric.
Mead-Morrison Mfg. Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

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Flower Valve Mfg. Co.
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Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.

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Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L. The.

Concrete, Reinforcement.
American Steel & Wire Company
Truscon Steel Co.

Concrete Sewer Pipe.
De Smet Quarts Tile Co.

Concrete, Tanks.
Mensch, L. J.

Concrete Tile.
De Smet Quarts Tile Co.

Conduits.
Cannelton Sewer Pipe Co.
Philip Carey Co., The.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
Artingstall, Wm.
Brossmann, Chas.
Burd & Giffels.
City Wastes Disposal Co.
Dow & Smith
Flood, Walter H., & Co.
Samuel A. Greeley
Howard, J. W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Potter, Alexander
Shields, W. S.
Van Trump, Isaac.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty
Warren Bros. Co.

Contractors' Tools and Machinery.
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Austin-Western Co., Ltd., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L. The.

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.

Cranes and Hoists.
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Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

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Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Crushed Stone.
Cleveland Stone Co., The

Culvert Molds.
Austin-Western Co., Ltd., The
Storms Mfg. Co.

Culvert Pipe, Cast Iron.
American Cast Iron Pipe Co.
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Culvert Pipe, Vitrified.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., Wm. E.

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Drag Scrapers.
Austin-Western Road Machinery Co.

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Philip Carey Co., The.
Pioneer Asphalt Co.
Truscon Steel Co.

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E. I. du Pont de Nemours & Co.

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Cincinnati Iron Fence Co.

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Hoists, Electric.
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Pawling and Harnischfeger.

Hoists—Motor Truck.
Columbian Steel Tank Co.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.
Barber Asphalt Paving Co.

Hydrants.
Flower Valve Mfg. Co.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Iron Fence.
Cincinnati Iron Fence Co.

Joint Fillers (Paving).
The Barrett Co.
Philip Carey Co., The.

Kettles (Portable).
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.

will allow $80,000 more of Fed. aid money to be used by the Buckeye State to aid in construction of permanent highway. Ohio projects approved are as follows: Cleveland-Wooster road, Seville to Medina, Medina Co., $45,600; Cleveland-Wooster road, Seville to Creston, Medina Co., $36,120.

Fla., Bradentown—$160,000 bonds voted to construct roads and bridges to Annamaria Island and Gulf Beach, Manatee Co., Bradentown Special Rd. and Brdg. Dist.

Fla., Tallahassee—State Highway Comn. considering paving (on top present shell road) 8 miles road south of Jacksonville to Goodby Lake, 16 ft. wide, vitr. brick; grade and pave 40 miles road from Brooks Co. (Georgia) line to Lake City, 16 ft. wide, Sanford Co., brick or asphalt. C. Brown, State Hwy. Engr.

Ill., Waukegan—Council intends to readvertise for bids this winter on $650,000 worth of paving here. Residents anxious to have improvements made.

Ind., Indianapolis—State Hwy. Comn. has authorized plans for construction of 120 miles of paved highways during 1921. Comn. plans to complete pavement of National Hwy. in Indiana, which will provide paved road running 140 miles across state—Richmcnd to Terre Haute. Comn. also plans improvement of 15 miles of roadway between Kendallville and Ligonier; 4 miles between Ft. Branch and Habustadt; also brdg. to cost $400,000 over White River at Hazelton.

Ind., Ft. Wayne—Resolution for improvement of Woodland avenue, Calhoun street to Lafayette, adopted by Bd. of Works. Widening of roadway 4 ft., in addition to paving it, is included in resolution. Tecumseh street, Edgewater avenue to Cochrane street, Erie, Hanover to Anthony blvd. and Tenn. avenue, St. Joe blvd. to Spy Run avenue will also be paved.

Ia., Des Moines—Paving program for next year includes 600,000 sq. yds. paving. John Budd, supt. of Station E, Douglas and Forty-second streets. A. E. McGlothen, City Bldg., City Clk. Est. cost, $2,500,000.

Ia., Ft. Dodge—Webster County will probably take bids this winter on gravel loading equipment for county pit. C. B. Stephenson, Engr. Jas. L. Hanrahan, Co. Auditor.

Ia., Ft. Dodge—Council will take bids in spring on about 36 miles perm. grading, about 8,000 cu. yds. to mile; also tile road draining and concrete culverts; also 15½ miles gravel, all on F. A. P. system; also 12 miles grading on secondary road system and 8 miles gravel road. Clarence B. Stephenson, Co. Engr., Webster Co.

Ia., Maquoketa—Jackson Co. Bd. of Supvrs. adoted resolution requesting State Hwy. Comn. to include additional road to primary road system through Preston, Miles and Sabula. M. Sagers, Aud.

Ia., Marshalltown—Bd. of Supvrs. will ask bids in December for 6 miles of paving. Co. Engr. H. O. Hickok preparing plans; 18 ft. wide, 7 ins. thick, crushed rock, sand and cement. Work to start in spring. W. E. McLeland, Aud., Marshall Co.

Ky., Covington—$150,000 bonds voted by city for improving Scott and Main streets and Decoursey avenue. Thos. F. Donnelly, **Mayor.**

Mich., Bessemer—Gogebic County Supvrs. making plans for road improvements. Est. cost, $136,000. Includes Superior, Lake Road, $15,000; highway 5 miles east of Wakefield, $23,750; resurfacing 20 miles west of Watersmeet, $21,000; tar macadam, 2¾ miles in city, $11,400. John Luxmore, Jr., Co. Aud., Gogebic Co.

Minn., Duluth—Commrs. have approved plans for widening and graveling Meadowlands trunk road between Hibbing and Duluth. W. H. Borgen, Aud. St. Louis County. $125,000.

Minn., Mantorville—Dodge County will call for bids soon for road machinery. Geo. L. Taylor, Aud. Dodge County.

Minn., Minneapolis—Bids for paving material to cover nearly $1,000,000 worth of paving will be called for in December. K. E. Alexander, City Purchasing Agent. E. R. Dutton, City Paving Engr.

Ohio, Cleveland—Commissioners Cuyahoga County plan to grade, drain and pave Broadway, E. Fifty-fifth street to Miles avenue; Chagrin River Rd., Mayfield Rd. northerly to county line; Detroit avenue, W. 117th street, to West Blvd.; North Ridge Rd. to Lorain Rd.; Lee Rd., Shaker Heights Village to Broadway; Lloyd Rd., Lake Shore Blvd. southerly; Depot Rd., county line; Royalton Rd. to county line; Spencer-Mastic Rd., Lorain to Columbia Rds.; York-Bennet Rd., Royalton Rd. to county line; Pleasant Valley Rd., Booster Pike to State Rd.; W. Madison avenue, through City of Lakewood; Prospect Rd. to Hunt Rd.; also Drake, Hall, Prospect, Ridge and Snow Roads. About $5,000,000. W. A. Stinchcomb, Court House, Engr.

Ohio, Bedford—Village will receive bids in spring for grading and paving East Haven subdivision, Willis and Tarbell avenues; brick on concrete base. R. T. Wright, Bedford, Engr.

Ohio, Cleveland—City plans to widen and pave Carnegie avenue, E. 55th to E. 89th streets; asphalt on 6-in. concrete base. About $155,045.

Ohio, Columbus—State Hwy. Dept., Columbus, plans to construct section of Cleveland-Wooster Rd. between Seville and Medina, at cost of $45,000; also section of Cleveland-Wooster Rd. between Seville and Creston, $36,120. Both are in Medina Co. Comn. also considering construction of following roads: Licking Co., Newark-Mt. Vernon Rd., concrete, $27,000; Seneca Co., Fremont-Tiffin Rd., bitum. macadam, $30,000; Hancock Co., Findlay-Delphos Rd., concrete, $20,000; Ross Co., Logan-Chillicothe Rd., gravel, $30,000; Guernsey Co., Cambridge-Newcomerstown Rd., concrete, $38,400.

Ore., Astoria—Taxpayers of Road District No. 1, embracing entire county outside incorporated cities and towns, held annual budget meeting recently and levied special tax for highway work amounting to $205,900.

Pa., Harrisburg—State and city are now agreed on widening of North Third street along stretch of Capitol Park. Driveway will be 48 ft. wide, a uniform width that will take some of the park terrace south of Pine street.

Ore., Grants Pass—Grants Pass-Crescent Rd. is to become an actuality; $800,000 available for project. It is proposed to improve the coastal road to Gold Beach, Del Norte County.

R. I., Rumford—Town Council recommends expenditure of $100,000 for construction of cement road on North Broadway and Massasoit avenue.

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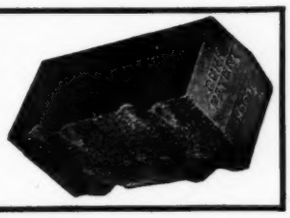

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Acme Motor Truck Co.
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Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co., The
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
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Municipal Castings.
Dee Co., Wm. E.
Madison Foundry

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

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Warren Bros. Co.

Paving Joint Compound.
Barber Asphalt Paving Co.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.

Paving Joint Filler.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co.
Good Roads Machinery Co., Inc.
Smith Co., T. L. The.
Warren Bros. Co.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co

Pipe Manufacturers.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

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Harris Air Pump Company.
Smith Co., T. L. The

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Sinclair Refining Company.
The Texas Co

Road Binder.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Sinclair Refining Company.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Cummer & Son Co. The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Mayer, F.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co.

Road Oils and Preservatives.
Barber Asphalt Paving Co.
The Barrett Co.
New Orleans Refining Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Rock and Sand Heaters.
East Iron & Machine Co., The

Roofing Material.
Barber Asphalt Paving Co.
The Barrett Co.
Philip Carey Co., The.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros.

Sand Dryers.
Cummer & Son Co., The F. D.

Saw Rigs.
C. H. & E. Mfg. Co.

Sandstone.
Cleveland Stone Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling and Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.
Electrolytic Sanitation Co.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.

Sewer Castings.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.
Clay Products Association.

Sewer Rods.
Stewart, W. H.

Sidewalks (Stone).
Cleveland Stone Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.

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Flower Valve Mfg. Co.
U. S. Cast Iron Pipe & Fdy. Co.

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Austin-Western Road Machinery Co., The

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Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co.

Stone Curbing.
Cleveland Stone Co.

Stone Elevators.
Austin-Western Road Machinery Co.

Stone Flagging.
Cleveland Stone Co.

Stone Spreaders.
Austin-Western Road Machinery Co.
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Crossings.
Cleveland Stone Co.

Street Flushers (Horse Drawn).
Austin-Western Road Machinery Co.

Street Paving Material.
Barber Asphalt Paving Co.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Co., Ltd., The

Structural Steel.
Lewis-Hall Iron Works.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Elgin Sales Corp.

Tamping Machines.
Pawling and Harnischfeger.

Tanks, Water Supply.
Mensch, L. J.

Tar and Pitch.
The Barrett Co.
Philip Carey Co., The.

Tar Heaters.
Littleford Bros.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith
Walter H. Flood
Howard, J. W.
Kirschbraun, Lester
Van Trump, Isaac.

Traction Engines.
Austin-Western Road Machinery Co., The

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
Austin Machinery Corporation.

Trench Braces.
Kalamazoo Fdy. & Mach. Co.

Trench Machinery.
Austin Machinery Corporation.
Kalamazoo Fdy. & Machine Co.
Pawling and Harnischfeger

Trinidad Lake Asphalt.
Barber Asphalt Paving Co.

Turbines, Steam.
De Laval Steam Turbine Co.

Valves.
Coldwell-Wilcox Co.
Crane Co.
Flower Valve Mfg. Co.

Wall Coping.
Cannelton Sewer Pipe Co.

Warrenite.
Warren Bros. Co.

Water Main Cleaning.
National Water Main Cleaning Co.

Water Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau

Waterproofing.
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.
The Texas Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

Water Softener.
The Refinite Co.

Water Works Supplies and Equipment.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau
Coldwell-Wilcox Co.
Crane Co.
Flower Valve Mfg. Co.
McNutt Meter Box Co.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Winches, Vertical Capstan or Friction Drum.
Mead-Morrison Manufacturing Co.

Wire Rope.
American Steel & Wire Company

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

Wood Block (Creosoted).
Barrett Co., The
Republic Creosoting Co.

Wood Preservatives.
Barrett Co., The
Republic Creosoting Co.

S. C., Columbia—Plans being prepared by Hwy. Dept. for construction of top soil road on Saluda Rd., Rock Hill to Chester Co. line. Bids soon to be opened for construction of top soil road in Dorchester Co., a distance of 17 miles. Plans being prepared at St. Hwy. office for new road from Pickens to N. C. line, and bids will be called soon for construction of Walhalla-Seneca Rd., 7 miles.

S. C., Columbia—State Highway Comn. plans to top soil 15 miles Dorchester-Reevesville Rd., Dorchester Co.; also 23.12 miles Chesterfield-Chesaw Rd., and 3.28 miles Washington-Atlanta Hwy., Chesterfield, gravel.

Tex., Austin—State Highway Comn. granted $100,000 state aid for construction of road in Stevens Co. known as State Aid Hwy. Nos. 36 and 43; also $400,000 aid for road in Woods Co.

Wash., Seattle—City Commission of Yakima passed two resolutions specifying streets to be paved and material to be used (17 blocks). North Third and North Fourth are to be paved from north line of A street to south line of R street, paving to be one-course Portland concrete cement paving, or a bitum. concrete paving having either Portland cement concrete or black base, or bitulithic pavement having either Portland cement concrete base or black base. This blk. is to be 50 ft. wide, comb. curbs and gutters, on both sides of streets; culverts, pipes and drains for draining and irrigation, and concrete walks at street intersections. Same general specifications apply to B, C and D streets from North Second to North Naches avenue. Comrs. decided to wait until first of year to call for bids, and expressed belief Feb. 1st would be best time to advertise for bids.

Wash., Seattle—Street Comm. of Council decided to proceed with improvement of Wilson avenue at once. Grading and sidewalking of important arteries will cost approx. $101,245. Work is in vicinity of Seward Park, and is known as "Wilson avenue project."

Wash., Seattle—Supt. of Railways Henderson recommended to Council the repaving of First avenue and First avenue south from Pine street to Atlantic street, and reconstr. of car tracks entire distance. Est. cost of new tracks and special work on street is $350,000.

Wash., Spokane—Approx. $207,000 will be expended next year on highways in Spokane County under supervision of county engineer's office. Harry Baker, Co. Engr. This fund is exclusive of bond issue road program for next year, which will involve, according to Commr. Ham, an expenditure of about $500,000.

Wis., Chilton—Calumet Co. appropriated $8,000 for road machinery, including one half hard steam shovel and three 2-ton trucks. Wm. Hoenig, Commr.

Wis., Eau Claire—Eau Claire Co. Bd. appropriated $15,000 for road machinery for 1921 road construction. Gay Osborne, Eau Claire, Commr.

Wis., Grand Rapids—Wood County plans to construct 3 miles Auburndale-Marshfield Rd., from corner Sec. 21, T. 25, N. R. 3 E., thence northerly to Marshfield, $95,000; Wisconsin Rapids-Sherry-Milladore Rd., sta. 158 plus 40 to sta., 197 plus 0, $16,000. E. Morris, Hwy. Commr.

Wis., Ellsworth—Pierce Co. Bd. voted $15,000 for purchase of machinery, including 2 trucks and loading outfit. C. F. Kenall, Commr. Marinette—Marinette Co. Bd. voted $5,000 for purchase of road machinery, including 2 wheeled scrapers. Andrew Eklund, Peshtigo, Commr. Richland Xtr.—Richland Co. voted $7,000 for purchase of road machinery, including a large truck, 1 cement mixer, 6 or 8 patrol graders, drags and planes. W. V. Robinson, Commr. Madison—Dane Co. Bd. appropriated $15,000 for purchase road machinery, including crusher, screens. F. M. Lipke, Commr; also $179,000 for graveling State Trunk Hwy. Green Bay—Brown Co. Rd. Brdg. Comm. will purchase complete paving outfit for 1921 road construction. Geo. J. Cormier, Commr. Racine—Racine Co. Bd. voted to expend $494,000 on concrete roads, as follows: $90,000 for grading, culverts and concrete paving in Rochester and Waterford Twps.; $157,000 Raymond Twp.; $112,000 in Mt. Pleasant Twp.; $35,000 in Burlington Twp.; $100,000 on Twelfth street road at Rochester, and extending easterly. W. O. Thomas, Commr.

SEWERAGE AND SEWAGE TREATMENT

Cal., Calexico—City Engr. Paul Entenmann has been instructed by City Trustees to prepare plans for 1½ miles additional sewer mains for city.

Cal., Orange—Resolutions adopted by City Trustees Nov. 1 to construct 6-in. vitr. pipe sewers with manholes and flush tanks in Chapman avenue, Water street and Jamison avenue, Center street, Orange street and Palmyra avenue.

Cal., Santa Ana—Survey for outfall sewer to ocean will be made by cities of Santa Ana and Anaheim, acting jointly. City Engr. W. W. Hoy, Santa Ana, and City Engr. O. E. Steward, Anaheim, will have charge of survey. Estimates of cost of rights-of-way and construction will be made and if project is found feasible steps will be taken to put it through. Sewer Supt. W. Wray, Santa Ana, recently warned trustees of necessity for providing some new plan to dispose of city's sewage, as present facilities are wholly inadequate. Anaheim is in practically the same position.

Cal., Watts—$120,000 bond issue for construction of sewer system and disposal system carried at recent election. Koebig & Koebig, Title Ins. Bldg., Los Angeles, Engrs.

Ill., E. Moline—Plans being prepared for building 4 miles 36-84 sewers in various streets. About $225,000. Alvord & Budrick, 8 S. Dearborn street, Chicago, Engrs.

Ill., Maroa—Council passed ordinance for sewerage improvements. Est. cost of improvement is $83,000.

Ill., Mt. Morris—Plans for sewerage system and sewage treat. plant for Sewer Dist. No. 2 have been approved by Div. of Engrg. and Sanitation, St. Dept. of Health.

Ill., Moweaqua—Ord. published which calls for installation of storm water and sanitary sewerage system for town, at cost of $100,000. Plans and specifications, which call for between ten and twelve miles of sewers, drawn by Miller, Holbrook & Warren, Engrs., Decatur, Ill.

Ind., Anderson—City Engr. Lamphear has been instructed by Bd. of Wks. to prepare plans for sewer to be constructed along Washington Blvd., in Colonial Addn. to city.

Ind., Bloomington—City having plans prepared and will receive bids between January 1st for enlarging sewage disp. plant. About $60,000. Alvord & Burdick, 8 South Dearborn street, Chicago, Engrs.

Ia., Ames—City will take bids about February for sewage disp. plant and outfall. Includes pumping station, mains, tank, etc. City Engr. P. F. Hophens, Ames. Est. cost, $125,000.

Ia., Bellevue—City plans to install complete sewerage system. About $60,000. Engineer not announced.

Ia., Ft. Dodge—W. L. Teng, City Clerk, will open bids in January for building extensions to sewerage system. About $40,000. C. H. Reynolds, Ft. Dodge, Engr.

Ky., Frankfort—$75,000 bonds voted to construct and install storm water and sanitary sewer through Glenwood to Thorn Hill and Jones' Bottom to Ky. River. W. S. Rosson, Mayor.

Mich., Negaunee—City Engr. E. J. Pearce preparing plans for new sewer system. Approx. 9,425 ft. 24-in. vitr. sewer pipe, 2 manholes, crossings, new connections, etc., at $101,800.

Minn., Annandale—Cons. Engrs. Druar & Milinowski, 512 Globe Bldg., St. Paul, preparing plans for sewer and water system. Work to start in spring. Geo. W. Shierts, City Clerk.

Minn., No. Branch—Druar & Millinowski, St. Paul, preparing plans for sewer system here. A. F. Johnson, City Clerk.

Minn., St. Paul—Carroll & Clausen, 1682 Lincoln avenue, St. Paul, retained by city to prepare plans and supervise construction of 5 miles proposed sanitary sewer system.

N. C., Hickory—$30,000 bonds voted for sewers. R. G. Henry, Mgr.

Ohio, Akron—It is planned to construct two remaining systems of Wolf Ledge Trunk sewer early next spring, according to J. E. Root, Supt. of Bureau of Sewerage.

Ohio, Marion—$1,000,000 bonds voted here to construct san. sewerage system and sewage disposal plant.

Ohio, Niles—City contemplates bldg. storm and san. sewers for one mile on Salt Spring Rd. Est. cost $31,600; 6,000 ft. in Red Run, $150,000.

Okla., Fort Gibson—Fort Gibson contemplates bldg. $75,000 sewer system to empty into Ark., River below Muskogee. Abt. 5½ miles pipe line measuring from 8 to 12 ins. would be necessary.

Ore., Portland—Plans for proposed sewer (Balch Creek) have been completed and will be filed with Council by Commr. Barbur within a few days. Est. cost $350,000. Sewer is proposed to care primarily for large industrial dist. in neighborhood of Guilds Lake region.

Pa., Easton—Plans for sewerage extensions in western section of city with system of sewage reduction by method employed at plant foot of E. Spring Garnde St., are in hands of St. Dept. of Health for approval.

Pa., Erie—Permission has been granted city by State Dept. of Health, for constr. of 2 sewer systems; one in southwestern and one in southern end of city. Total cost of two systems, about $50,000.

Pa., Philadelphia—Plans approved for three new sewage disposal units. Work will begin early in Spring. $300,000 now available for impvt. of which $250,000 is to be applied to a sewage pumping station, with capy. of 50,000,000 gals. daily. Remaining $50,000 will be combined with probably $500,000 out of general impvt. fund. There will be abt. 120 mi. of sewers built

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and abt. 10 miles ditches, latter averaging in depth 8 ft. and in width 30 ft.

S. D., Kennebec—Will probably take bids this Winter on sewer system and extensions to present water works system. W. C. Buck, Cons. Engr., 1245 W. Minnehaha Pkway., Minneapolis. Est. cost $30,000.

Tex., Ft. Worth—City has retained G. P. Smith, Engr., Ft. Worth, to prepare plans for ditching and laying san. sewers in Seminary Hill Addition. Abt. $50,000.

Tex., Houston—$75,000 bonds voted for constr. of storm sewers and drainage; $100,000 bonds voted to construct san. sewers.

Wis., Ellsworth—Druar & Milinowski, 512 Globe Bldg., St. Paul, Minn, have prepared prelim. plans for sewer system here. Work will start in Spring. M. D. Wood, City Clk.

Wis., Janesville—Work postponed until 1921 on about 6 miles of san. sewers. City Engr. C. V. Kerch.

Wis., W. Allis—City officials planning many additions to storm and san. sewer systems coming year. Storm sewer system is in course of construction and large addns. are being made each year. Money for financing the constr. is to be raised by direct taxation and City Engr. has been instructed to estimate probable cost.

Wis., Weyauwega—Engr. W. G. Kirchoffer, Madison, preparing prelim. plans for sewer and water system here. L. D. Post, Vil. Pres.

WATER SUPPLY AND PURIFICATION

Ark., Atkins—Prelim. plans prepared by Ford & MacCrea, Engrs., 326 Gazette Bldg., Little Rock, for impvt. of water works and sewer systems. About $120,000.

Ark., Booneville—Arrangements about completed for constr. of a water works system for city. Actual work will be commenced as soon as Council passes Ord. creating Impvt. Dist. There is very little, if any, opposition to the proposition at this time.

Cal., Glendale—City Trustees have voted to go ahead with water works impvts. and extensions under bond issue. City Mgr. Watson indicates that most urgent projects which it is proposed to carry out are as follows: Pumping plant at San Fernando Rd. (revised estimate) $38,300; 30-in. main on Glencake Ave., $50,000; Grand View reservoir at 820 ft. level, $52,500, including pressure main; large reservoir at entrance to Verdugo canyon, $70,000. H. G. Lynch, Van Nuys Bldg., Los Angeles, Engineer.

Cal., Redding—Pacific Gas & Electric Co. will expend approx. $20,000 for improvement of water supplies in Redding.

Cal., Vallejo—$1,250,000 bonds voted by city to bring water from Gordon Valley for city and navy purposes. Project involves bldg. reservoir of 2,000,000,000-gal. capy., 75-ft. earthen dam and 12 miles pipe line of 5,000,000-gal. daily capy. T. D. Kilkenny, City Engr.

Ont., Almonte—Report and ests. prepared by A. F. Macallum, City Engr. for water works system, to include intake, supply system, pump house, filters, reservoir, distribution system, etc. Approx. $263,695.

Ct., New Britain—City contemplates developing first unit of underground waterway sources adjacent to the Whitville Reservoir pipe line. Work includes water sheds, wells, pumping plant, etc. J. D. Miller, City Engr. Hazen, Whipple & Fuller, 30 E. 42nd St., New York City, Cons. Engrs. Total cost to exceed $3,000,000.

Ill., Moline—Construction of a 10,000,000-gal. reservoir advocated by Stephen E. Buck, Supt. of Moline water works. Council water comm. ready to endorse the reservoir project.

Ill., Pana—Steps taken to increase water supply and huge reservoir will be built next year to hold 500,000,000 gallons.

Ind., E. Chicago—City having plans prepared by Greeley, Pearse & Hansen, Cons. Engrs., 39 W. Adams St., Chicago, Ill., for pumping station. About $150,000.

Iowa, Mason City—City has voted in favor of $300,000 bond issue for impvt. of water works. J. H. McEwen, City Clk.

Ky., Ashland—$250,000 bonds voted for impvt. of water and pumping station; erection of filtr. plant; extension and cleaning of mains, install. meters, bldg. addn. reservoir, etc.

Ky., Covington—$250,000 bonds voted by City for impvt. of water works; install. of 10,000,000-gal. electric triple expansion pump. Thos. F. Donnelly, Mayor.

Ky., Nicholasville—$56,000 bonds voted here for purchase of water system; extension of plant, $20,000; install. pumps, air compressor and chlorinator, $9,000.

La., Lake Charles—City will lay water mains on 33 streets in City. Entire impvt. to water works system will involve expendt. of $445,000.

Md., Baltimore—City considering expendt. of 5,500,000—raise Loch Raven concrete dam 240 ft.; increase poundage of water to yield 146,000,000 gals. daily. Wm. A. McGraw, City Engr.

Md., Frostburg—$250,000 bonds voted to improve water supply system.

Mich., Marquette—Council has passed resolution providing for install. new pumping station and equipt., install. additional intake main, constructing auxiliary storage tank (200,000 gals. capy.) and repairing water distribution system.

Mich., Ramsey—Plans being prepared by Alvord & Burdick, Engrs., 8 S. Dearborn St., Chicago, for new water works system. About $75,000.

Minn., St. Paul—$3,000,000 bonds voted for enlarging water plant, involving 8 miles pipe line in Mississippi River, pumping station, filter plant, etc. O. Claussen. City Engr.

Okla., Vinita—$460,000 bonds voted for constr. of dam, 5-mile pipe line, purification plant, tower and intake on Little Cabin Creek. H. G. Olmstead & Co., engrs., 415 Oil Exch. Bldg., Okla. City.

Tex., Phaar—$1,500,000 bonds voted here for impvt. of water works; Hidalgo Water Impvt. Dist. No. 2.

Wis., Racine—City will make impvts. and extensions to water plant to cost $1,936,000. Chas. Ryba, City Clk.

Wis., Wausau—Wisc. Valley Impvt. Co., constr. of water works system, to include Prince, Nixon & Co., Omaha, Neb., Engrs. Voir and dump house, etc. About $75,000.

Wyo., Douglas—City soon to ask bids for collecting system below River bed, reservoir. Wausau, has petitioned Railroad Comm. for authority to construct storage reservoir on Spirit River and to issue an additional $100,000 worth of stock.

Wis., W. Allis—City officials preparing plans for water supply. New pumping station equipped with 2 centrif. pumps, elec. driven, capy. of 2,500,000 gals. a day; also reservoir near Woodlawn and Lincoln Ave., for emergency supply. A. L. Wichner, City Clk. A. Schneider, City Engr.

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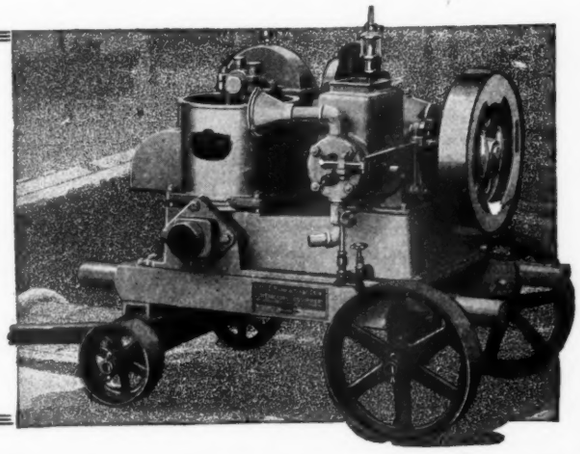

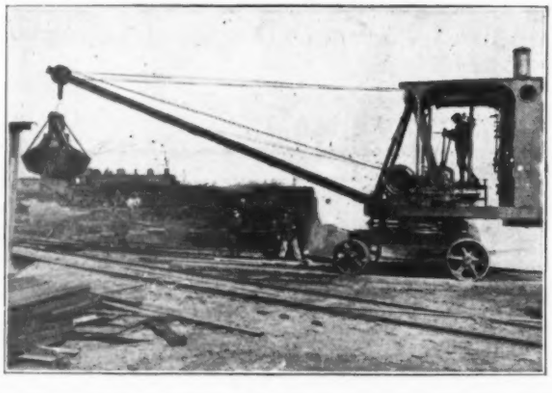

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